THE

FOUNDRY TRADE JOURNAL

WITH WHICH IS INCORPORATED

THE IRON AND STEEL TRADES JOURNAL

VOL. 46. Thursday, June 9, 1932. No. 825.

PUBLISHED WEEKLY.

Subscription Terms: 15s. per annum.
Foreign and Colonial: 17s. 6d. per annum.
All Subscriptions are payable in advance.

All Communications to be addressed to the Editor, the Advertisement Manager, or the Publisher of
THE FOUNDRY TRADE JOURNAL,
49, WELLINGTON STREET, LONDON, W.C.2.

Telegraphic Address: "Zacatecas, Rand, London."
Telephone: Temple Bar 3951 (5 lines).

Contents.

	PAGE
Welfare—Its Use and Abuse	347
The Rotary Furnace	347
Seeking a Line of Demarcation	348
Publication Received	349
Correspondence	349
Random Shots	349
Quantity Production of Grey-Iron Castings ...	350
Ferrous and Non-Ferrous Metals in the Foundry	354
This Week's News in Brief	358
Trade Talk	358
Obituary	358
Personal	358
Raw Material Markets	360
Students' Corner	360

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES' EQUIPMENT AND SUPPLIES ASSOCIATION.

Institute of British Foundrymen.

PRESIDENT: 1931-32:

A. Harley, The Daimler Company, Limited, Daimler Works, Coventry.

LIST OF SECRETARIES—

General Secretary: T. Makemson, Saint John Street Chambers, Deansgate, Manchester. London Office: 49, Wellington Street, London, W.C.2.

Birmingham: F. K. Neath, 24, St. Paul's Square, Birmingham.

Sheffield: T. R. Walker, 33, Ladysmith Avenue, Nether Edge, Sheffield.

Scottish: J. Bell, 60, St. Enoch Square, Glasgow.

Lancashire: J. E. Cooke, 1, Derbyshire Crescent, Stretford, Manchester.

London: H. W. Lockwood, Stewarts & Lloyds, Limited, Winchester House, Old Broad Street, London, E.C.2.

Newcastle-upon-Tyne: J. W. Eckford, 4, Mosley Street, Newcastle-upon-Tyne.

East Midlands: H. Bunting, 82, Otter Street, Derby.

West Riding of Yorkshire: S. W. Wise, 110, Pullan Avenue, Eccleshill, Bradford.

Wales and Monmouth: J. J. McClelland, 12, Clifton Place, Stow Hill, Newport, Mon.

Middlesbrough: F. A. Harper, "The Briars," Bishopton Road, Stockton-on-Tees.

Foundry Trades' Equipment and Supplies Association.

President: D. H. Wood,
Titan Works, Charles Henry Street, Birmingham.

Secretary: K. W. Bridges, Grand Buildings, Trafalgar Square, London, W.C.2.

Welsh Engineers' and Founders' Association.

Secretary: E. J. Griffiths, 2, Royal Metal Exchange, Swansea.

BRITISH CAST IRON RESEARCH ASSOCIATION.

The Registered Office and Laboratories of the B.C.I.R.A. are at:—
21-23, ST. PAUL'S SQUARE, BIRMINGHAM.
Telephone: Central 1893. Telegrams: CIRA.
The B.C.I.R.A. Scottish Laboratories are:—
Foundry Technical Institute, Meek's Road, Falkirk (*Telephone 332.*)

Welfare—Its Use and Abuse.

Elsewhere in this issue we review a pamphlet issued by the Industrial Welfare Society, entitled "The Introduction of a Work's Welfare Scheme." We heartily endorse the creation of welfare schemes for certain types of works, especially those large organisations situated in the heart of the country. The Stanton Ironworks Company readily comes to mind as an outstanding example of excellence. The underlying principle is wrapped up in the answer to the question as to whether outside and uncontrolled organisations offer facilities for recreation and thrift, and whether the majority of the employees are of the type to take advantage of those facilities. In some areas this work is shared between the religious bodies and the licensed victuallers. There are other cases, where the type of employee is such that no internal effort is either necessary or appreciated, as in the London suburbs, where ample facilities exist for recreation, whilst thrift can be left to their intelligence and the attentions of insurance agents. As 98 per cent. of the factories of Great Britain employ less than 100 people, the organisation of welfare schemes would normally rest upon the ephemeral enthusiasm of one individual. Now, it so happens, that the Factory Acts impose upon the management of works a multiplicity of rules and regulations, the generous and meticulous interpretation of which, to our mind, forms the essentials of any welfare effort. A scrupulously clean, well-lighted, well-ventilated factory, possessing properly safeguarded machinery and adequate sanitary accommodation is suggested, if not definitely enforced by law. If the management has provided these, in the spirit of the law rather than in its legal aspects, they have conferred a real boon upon their staff. A canteen is not necessary where the location of the works is such that the majority of the employees can return home for their midday meal, but where this is not generally possible, a co-operative effort is essential. Thrift and recreational activities should only be organised where a real demand exists. If it is thought that by reason of inadequate local housing conditions or isolation of district the evenings of the employees are likely to be gloomy, then a real effort is worth while. In many districts, especially the newer manufacturing areas, where the local councils are lavishing money on providing recreational facilities, it is only a duplication of effort for the management of the works to enter this field of activity. Just one more phase, and that is the provision of first-aid boxes. This essential should always be on a more generous scale than is strictly warranted by either the vocational activity or numbers employed. In any effort made by a works in the direction of welfare, all literature of American origin should be discounted, because in Britain there is no such thing as a labour-turnover problem, whilst, because of generations of factory life, there is an inherent "factory sense" or "safety-first" instinct. Thus no basis for comparison exists for drawing reliable conclusions.

The Rotary Furnace.

The Paper published in our last issue on the pulverised-fuel rotary furnace comes very opportunely on the eve of the Newcastle conference, at which the visitors will have opportunities of seeing these furnaces in operation. Installations of both the well-known types have recently been put into operation, and other furnaces calculated to perform the same duty have appeared, so that the progressive founder will have ample opportunity of making a choice. The main handicap, we imagine, to their more general adoption, especially at the present time, will be that of capital cost. Founders not able to visit the conference will also be particularly grateful to Messrs. Scott & Dawson for the frank way in which they have presented their experiences and conclusions. The success they have achieved is alike a credit to them and to the furnace, and their results will be of inestimable value to other users, of whatever type of pulverised fired melting plant.

We should like to venture a word of caution with respect to the use of charges mainly or wholly of steel scrap. We suggest that it is not yet proved that castings made from a steel charge are in every respect equally as satisfactory as those made from ordinary pig and scrap. In some respects they may be better, but in others they may be proved as less satisfactory. The great test, of course, is that of service, and some time must elapse before the effects of this become known. Furthermore, the general use by founders of steel scrap may tend to increase the price of steel scrap, at any rate locally. This is recognised in America to such an extent that licences for the use of one steel-scrap-using process are limited in a particular territory. Of course, the furnace is not obliged to use steel scrap and can also employ pig-iron, but a fairly regular demand for pig is a condition of the functioning of a blast furnace, and foundrymen may well ask themselves very seriously whether it is to their commercial interest to identify themselves too much with processes excluding the use of pig-iron or cast-iron scrap. Not a few founders have found to their cost in the past year or so that they get into difficulties when, through falling demand, a blast furnace on whose products they have relied perhaps for years has gone out of blast, possibly permanently. The indebtedness of the new process to modern metallurgical investigation is evident, for the results are obtained because of the understanding which now exists of what actually happens when cast iron is melted, compared with the state of knowledge ten years ago.

XUM

Seeking a Line of Demarcation.

GREEN OR DRY-SAND MOULDING.

At a meeting of Edinburgh Section of the Institution of British Foundrymen, recently held in the Heriot Watt College, Chambers Street, Edinburgh, Mr. W. Wallace occupied the chair, supported by Mr. N. McManus, M.B.E., Scottish Branch-President, and Messrs. Campbell and Currie, Vice-Presidents, the subject of the line of demarcation between green- and dry-sand moulding was discussed. The Chairman said that he was gratified to see so large an attendance of East of Scotland foundrymen, and gave a hearty welcome to a number of visitors, many of whom he hoped would be induced to join the Institute. He had no intention of taking up their time with a long speech, and would at once introduce to them Mr. Henry Gardner, of Messrs. Glenfield & Kennedy, of Kilmarnock, who had very kindly come through to read a Paper and give his views of the foundry from an engineer's outlook. He was sure that they would be interested in listening to what Mr. Gardner had to say to them, and he hoped at the end freely discuss the Paper.

Mr. Gardner then read a Paper on "An Engineer's View of the Foundry." The Paper was substantially the same as that published in our columns on January 7.

DISCUSSION.

Mr. A. D. MacKenzie said that he thought that Mr. Gardner assumed that everything which looked like an engineer's job was bound to be good, but personally he thought that was not true in its entirety. The sandslinger, for instance, was an engineer's job, but although it was excellent for some castings, it was, in his opinion, not so good for others. The same could be said about the machines which Mr. Gardner had shown making hand wheels. He had seen the core-blowing machine which had been described, at work when he was in Germany, and, although he thought that it was an awfully clever machine, it had its limitations, as it could only be applied to the making of simple cores; perhaps, if Mr. Gardner had seen it working on larger and more intricate work, he could give them further information.

Mr. H. Gardner said, regarding Mr. MacKenzie's remarks about the sand-slinger, he had gone into the question very carefully before adopting it in their heavy foundry. It was certainly not suited for every job, and there were a number of things to be taken into consideration. They had, for instance, had to control the type of box used very carefully. They had two machines in Glenfield Works; the first one was of American origin, and the second British built, and he was glad to be able to state that the British machine was definitely ahead of the American. They had found the slinger machine extremely useful in their light foundry, otherwise they would never have introduced it into the heavy shop. He agreed with Mr. MacKenzie that the core-blast machine was only suitable for comparatively plain and light cores for repetition work.

The Chairman said that he would remind the meeting of a question which Mr. Gardner had raised, and one which he as an engineer would like to hear answered was, what was the limit to green-sand moulding?

Steam Generation as Controlling Factor.

Mr. Arthur Bruce said that, in his view, the question of making large castings in green sand was a question of the amount of steam. In a large mould there was more steam, and it took a longer time to fill the mould with metal. As steam and metal were inclined to quarrel and cause a commotion, the result was that holes were blown. Regarding the casting without meads, it all depended upon the pressure which the cylinder had to stand. He had to make cylinders to stand 2,500 lbs. test pressure, and always found that casting with a good head gave the sounder and better casting.

Mr. Gardner said that, as concerned the casting in green sand or dry sand, it was a fact that castings in green sand had been made much heavier in recent times, and he thought they could go a little further yet. What he wanted to arrive at was, where was the dividing line and what constituted the deciding factor? In his own foundry, they had gone a good way by gradual steps, but he could not get his foreman to say why he preferred dry sand to green sand. It appeared to be simply a question of the risk, and there was no doubt the foundryman looked to the engineer to take the risk and responsibility. He thought that the engineer would have to take the risk and say "Go on and make the job in green sand and I will take the responsibility." In regard to heads, it appeared to be very much a matter of fashion, and use and want. A few years ago very large heads were fashionable; in many cases more metal was in the head than in the casting. In the case of the large hydraulic valve shown they had at one time always cast with a head as heavy as itself, as it had to stand a test pressure of 2,500 lbs. They cast those cylinders without a head now, and obtained them quite sound and solid. His opinion was, that if a head was really necessary to save a casting, by all means use one, but if it could be cast without a head, do so.

Phosphorus Content and Feeding Heads.

Mr. N. McManus asked whether it was the case that the use or otherwise of a large sinking head was largely a question of reducing the percentage of the phosphorus in the metal? Could Mr. Gardner give them the analysis of the metal? Was the metal in the casting with the head the higher phosphorus?

Mr. Gardner agreed that it was largely a question of controlling the metal composition and melting. The metal used for headless castings was of lower phosphorus content.

Mr. Wallace said that they cast large cylinders at his foundry, but he did not think they used anything much in the way of heads. Perhaps Mr. Bruce could enlighten them.

Mr. John Bruce said he cast them all without heads—even the biggest—and experienced no difficulty, even with valves or cylinders.

Mr. J. Inglis wondered why so much fuss was always made about cores. Why could they not eliminate most of the cores and use shell patterns. Was that not possible with a moulding machine.

Mr. John Wilson, referring to green sand or dry sand for large moulds, said he could not see why the 10-ft. diameter ring should not be cast in green sand as easily as the 6-ft. one, provided the mould was in order. Green sand had to be properly handled and was a much more skilled job than dry sand. If the mould was properly rammed in green sand, he thought, the casting could easily be made. The chief trouble was getting good green-sand moulders, as at the present time they were scarce.

Box Strength as Criterion.

Mr. Landale said that there was a point which ought to be considered in deciding the limits for green-sand moulding, namely, the spring. In a large box there was a good deal more spring and, coupled with the fact that green sand was softer than dried mould, it would be more likely to fall out. He thought that would be his main reason for deciding upon dry sand for a large mould. It had been mentioned that there would be more steam evolved from green sand, but if the mould had plenty of vents and ample risers, steam would succeed.

Mr. J. Currie asked what was the idea of wishing to make the job in green sand; was it simply cheapness? He thought that it required just as much work in moulding and as much finishing as in dry sand. There would only be the drying extra, and there would not be much in that, and they would have a safer job.

Mr. Gardner pointed out the dual factors of economy and cheapness. There was no doubt that green sand was cheaper than dry sand. The sluice gate, for instance, which he had shown, was certainly more expensive, as they had to make special plates and tackle to put it into the stove.

Mr. Currie asked if Mr. Gardner could give the difference in the moulding time and the appearance of the casting in the case of the sluice frame.

Mr. Gardner said he had not the exact figures with him, but in the case of a similar job to that shown, having an overall diameter of 12 ft. 6 in., there was a very great saving and the job was done more expeditiously.

Mr. Currie, in coming to a decision as to whether green sand or dry sand should be employed for a job, said there was not one, but several, lines of demarcation to be considered. One was the moulders available and another was the tackle available in the establishment. It was really a very difficult question to answer.

Mr. Gardner, whilst realising that, said it was the reason he wished to hear their views and to have the matter adequately discussed.

A Non-Existent Line.

Mr. Graham said that they had heard from Mr. Gardner as an engineer looking at the founder, but he as a foundryman looking at the engineer thought that the engineer expected the foundryman to become a machine or a part of a machine. That was not possible, because the foundryman had to deal with the laws of nature, such as gravitation, shrinkage, contraction and freezing, and to do that he had to use his best judgment according to the job in hand. The engineer had not to do that to the same extent, as he got machines to do most of his work, and, in fact, the engineer was really part of a machine, whilst the foundryman was not and never could be. He wished to say that no definite line of demarcation between green sand and dry sand was possible, because conditions were variable, and what was possible in one foundry was not possible in another. He knew, for instance, a foundry in which certain work was impossible on account of water accumulating below a certain depth and hardly any green sand could be depended on, except very small moulds. It was all very well for the engineer to say that there should be a line of demarcation so that they could say where to start and where to finish, but when the engineer had to fight against the forces of nature as the foundryman had to do, he would have a different idea.

Mr. Gardner said he quite agreed that engineers were making greater demands upon the foundryman on account of increased speeds and severity of service conditions. He did not wish to make the founders fight among themselves or with the engineers, but wished to work together.

A New Tool?

Mr. Menzies said that he had the misfortune to operate a foundry within 3 degrees from the tropics and had a certain number of difficulties to overcome. The engineers there asked the same questions as Mr. Gardner had asked. The son of nature had just spoken and had referred to the difficulties with which the foundryman had to contend. They certainly had their difficulties in this country, but where he worked

they had their troubles. In his foundry jobs could often be made in green sand, but they usually cast them in dry sand to make sure of the result. He agreed with Mr. Currie that there was only the drying cost extra in the case of dry sand and there was really little in it. He had been interested in Mr. Gardner's remarks about shovelling, but the men in his foundry had never seen a shovel. They used a tool called a shuckle which was like a hoe. They could shift not 6 lbs. but 6 yds. with this tool.

MR. A. BRUCE said he very often thought it was not worth the risk making in green sand. He had recently made 6-ton castings in green sand and in dry sand but the former required much more properly skilled moulders. The speed was greater in dry sand than green sand. The decision as to the method to be used depended a good deal on the class of pattern. With a good pattern to draw easily green sand was satisfactory, but if it did not draw easily there was a quantity of making up to be done and also a danger of scabbing. Younger and less skilled men could be put on to the job if it was in dry sand.

MR. WILSON: That just proves my point; it all depends on the moulders available.

Vote of Thanks.

The CHAIRMAN said that he could realise the position in which Mr. Gardner was placed. He asked them to try and realise the engineer's point when he heard of all the mystery as to the method and cost of moulding and yet be shown a splendid casting from either method. He was afraid that many engineers like himself could find no moulders but a very expensive plant they were maintaining. In the case of repetition methods of producing castings, it was

(*Concluded on page* 360.)

Publication Received.

The Introduction of a Works Welfare Scheme. Published by the Industrial Welfare Society, 57, Palace Chambers, Westminster, S.W.1.

This is a veritable text-book on the subject of welfare, and as such should be in the hands of every foundry owner. Whilst we do not agree that all the phases detailed are either necessary or desirable in any industrial organisation, we allow that some of the phases are essentials. This activity is a combination of a charity and business, designed to replace the ideal—that is, the master working side by side with his man and understanding all his aspirations and difficulties, both domestic and in connection with his work. The skeleton of the book is a well-balanced outline of welfare organisation, derived from studies of the experience gained by the Home Office, the members of the Industrial Welfare Association and the publications of the industrial psychology societies. Much of this is set out in the form of rules for the guidance of clubs created for the specific purpose of some phase of welfare. We do not pretend to be expert in the science of economics, but, glancing through the list of deductions from wages and knowing something of industrial conditions, we have grave doubts as to the wisdom of too much welfare. Primarily, every skilled workmen must pay health and unemployment insurance weekly, and if in addition he has to pay subscriptions to a savings club, a holiday fund, a tool club, a medical fund, a social and athletic club, it leaves very little for his wife to buy food and household necessities and pay the instalments on the furniture, the gramophone, the wireless and the like. However unquestionable it is not necessary for works to indulge in every activity and the rules outlined are excellent, and, obviously, have sound experience at the back. We gather the publication is available to foundry executive officers for the asking.

Correspondence.

Soda Ash.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I do not lay claim to be the inventor of the application of soda ash for the desulphurisation of ferrous metals, but my patented system of lining ladles constituted an important factor for the successful prosecution of the process. The first indication that such a development was necessary appeared in the American technical Press, wherein an author stated that, whereas the desulphurisation process by soda ash was a theoretical success, its practical application was being retarded owing to the non-existence of a lining capable of withstanding the scoring effect on the acid linings they normally employed. The results achieved were extremely erratic, and until the appearance of my process reliability was unknown. It is interesting to note that American practice was stated to destroy a lining within seven heats, accompanied by skulling, whereas my lining regularly gives a ladle life of 200 times, when a yield of 50 per cent. reduction in sulphur content is being achieved, associated with the complete elimination of skulls. The process was developed in the foundries of Messrs. Kryn & Lahy, Limited, in 1928.—Yours, etc.,

J. A. JACK.

Letchworth, June 6.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I read in an article published in the June 2 issue of THE FOUNDRY TRADE JOURNAL a reference to my firm as being an early user in this country of soda ash for the desulphurisation of liquid cast iron. It will probably interest you to know that I employed this method in our foundry after having read, in the issue of October 8, 1925, of your JOURNAL, an account of a lecture given on this subject before a meeting of the American Foundrymen's Association by Mr. S. R. Robinson, metallurgist of Messrs. Industrial Works, Bay City, Michigan.

Ever since then we have been desulphurising our cupola metal regularly, and we have developed a technique which ensures with great regularity the removal of 40 to 50 per cent. of the sulphur from the metal.

We have definitely established by numerous tests that, in addition to the beneficial effect it has on our steel (which we make here by the surface blown converter process), resulting from a reduction in the sulphur content of the molten metal obtained from the cupola, the use of soda ash yields the additional advantage of producing a much cleaner metal, this being due probably to the physical action caused by the evolution of CO_2 liberated by the decomposition of the carbonate of sodium and which, rising to the surface of the molten metal through the bath, carries with it the non-metallic inclusions in suspension in the metal.

At first we experienced difficulties with the refractory lining of our desulphurising ladles, which was made of ordinary ganister and was rapidly destroyed by the strongly basic Na_2O, but this trouble was soon overcome by the provision of a suitable refractory lining of a neutral character, and we are now able to obtain as many as 150 to 200 heats from one ladle without having to reline it.

You will see from the above that the writer does not wish in any way to take the credit for the *invention* of the application of soda ash to the desulphurisation of cupola melted metal, which was used for many years before 1925 in U.S.A. and Germany, but he believes that his firm was the first to employ this process on an industrial scale in this country.—Yours, etc.,

J. DESCHAMPS,
General Manager.

Kryn & Lahy (1928), Limited,
Letchworth, Herts.

Random Shots.

By the time "Marksman's" remarks appear in print this week the Convention will have reached its final stages. Mr. Victor Stobie will have been installed as President; the Convention Papers will have been presented and discussed; and everybody, no doubt, will have had the opportunity to agree that Newcastle once again has been the centre of a highly-successful conference. Were "Marksman" an experienced newspaper man, he would have been able to record his impressions of the opening day of the Convention in this issue. As he is not, he just has to wait, like any other man in the street, for an event to happen before writing about it. So he will have something to say of the Convention next week. In the meantime, *pax vobiscum!*

* * *

One of our national advertisers, I notice, is now regaling us with intimate little pictures of "Mr. Can" and "Mr. Can't." And one wonders what would result if this idea were to be introduced into the advertising pages of our technical journals. Something like the following might appear:—

"Mr. Can't mooches round his foundry with a very dismal expression on his face. But can you wonder at it when the scrap heap piles itself up so quickly? The percentage of wastes in Mr. Can't's works is probably higher than in any other foundry in the country. That's because there is something wrong with the metal. Nobody can produce sound castings if the metal is defective.

* * *

"But just look at Mr. Can. His foundry is in full swing. His order-books are well filled. Mr. Can has only one problem, and that is how to keep pace with demand until his new works are completed. Mr. Can, you see, is renowned for the quality of his castings. Large or small, they are all as sound as a fiddle. And that's because he uses '343,' the new super-metal improver. A pinch of '343' added in the ladle makes the metal clean and sound."

* * *

Here are one or two stories which seem to "Marksman" to be rather new:—

The young athlete wrenched open the door of the railway carriage, tumbled inside, and collapsed on the seat gasping for breath as the train slid out of the station. A retired athlete in the opposite corner grunted.

"When I was your age, my lad," he said, "I could sprint down a platform and catch a train without turning a hair."

"But I—missed this—at the—last station," panted the youth.

* * *

Mose was arrested for speeding. It was his fifth offence and as he appeared before the Judge he muttered something that sounded suspiciously like an oath. "Repeat that," thundered the Judge. "Ah didn't say nothin', Jedge," said Mose. "You did say something," said the Judge . . . "and I want you to repeat it." "Well, all I says, Jedge, was 'God am de Jedge, God am de Jedge.'"

MARKSMAN.

Africa's Longest Bridge.—Claimed to be the largest structure of its kind on the African Continent, the new rail and road bridge built across the river Benue at Makurdi, Nigeria, was opened on Empire Day by the Governor of Nigeria, Sir Donald Cameron. The bridge, which has taken just over four years to construct, at a cost of nearly £1,000,000, was built by Sir William Arrol & Company, Limited, who prepared at their Dalmarnock Ironworks, Glasgow, 8,600 tons of steelwork for the bridge spans and foundations. This bridge is 2,584 ft. long between abutments, and consists of 13 spans, three of which measure 240 ft. each and ten 180 ft. each.—"Modern Transport."

Quantity Production of Grey-Iron Castings.

By J. O'Sullivan.

An event of outstanding interest to foundrymen is, undoubtedly, the opening of the Ford foundry at Dagenham. The Cork foundry of Messrs. Henry Ford & Son, which has been in existence for the last twelve years, cannot claim to be as modern as the foundry at Dagenham will be, but the processes developed in the River Rouge plant at Detroit and Cork are the foundations upon which the Dagenham foundry has been designed. Though the methods of quantity production will be familiar to many, yet the synchronisation of these methods may present some new angles, and, therefore, it is proposed to concentrate on the sequence of operations rather than to present a detailed account of them. The chart (Fig. 1) is intended to illustrate the synchronisation employed and its skeleton forms the basis of this Paper.

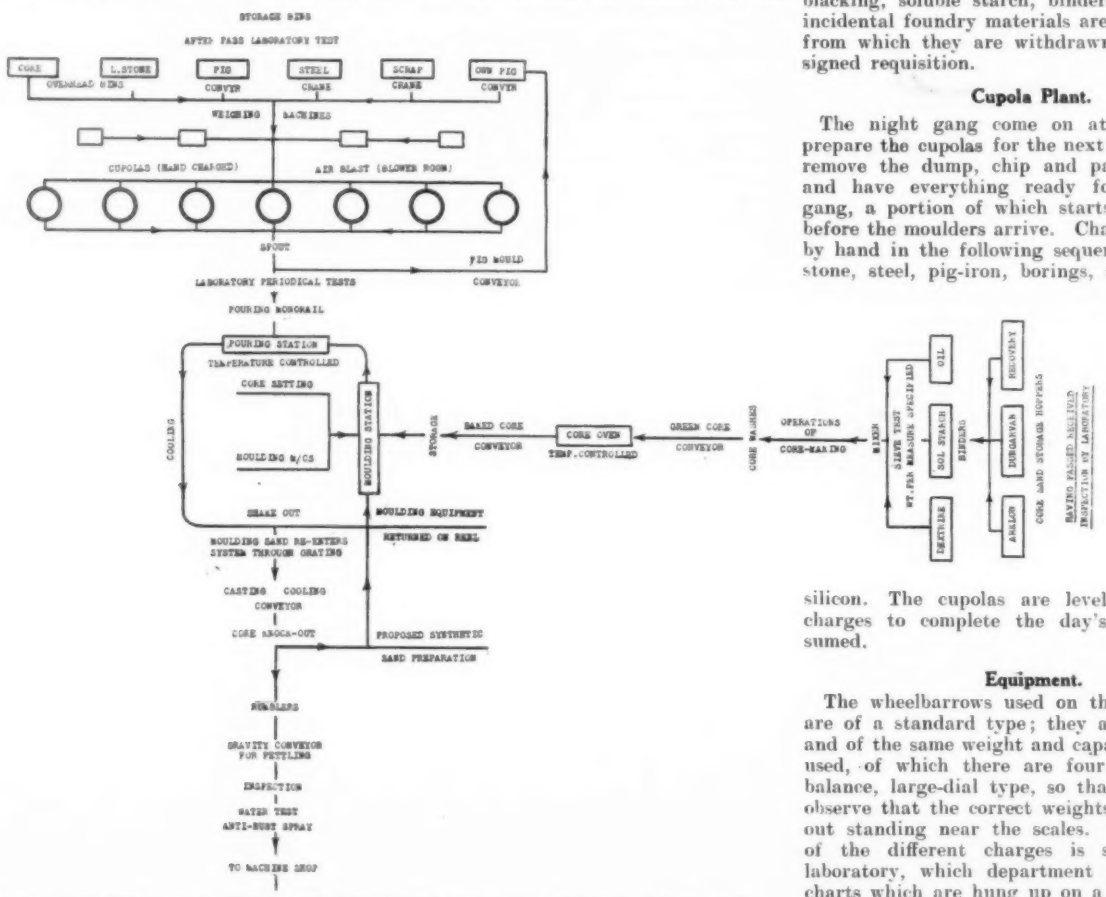


FIG. 1.—CHART INDICATING THE NEED FOR SYNCHRONISATION IN QUANTITY PRODUCTION.

Laboratory.

After having passed inspection by the laboratory, the incoming bulk raw materials, embracing pig-iron, coke, scrap, sands, clays, are loaded into conveniently-situated storage bins; whilst the less bulky commodities, such as core wire, blacking, soluble starch, binders, oil and other incidental foundry materials are put into stores, from which they are withdrawn only against a signed requisition.

Cupola Plant.

The night gang come on at ten o'clock to prepare the cupolas for the next day. This gang remove the dump, chip and patch the cupolas and have everything ready for the charging gang, a portion of which starts work one hour before the moulders arrive. Charging is all done by hand in the following sequence: Coke, limestone, steel, pig-iron, borings, scrap and ferro-silicon. The cupolas are level until sufficient charges to complete the day's work are consumed.

Equipment.

The wheelbarrows used on the charging floor are of a standard type; they are well balanced and of the same weight and capacity. The scales used, of which there are four, are of spring-balance, large-dial type, so that one can easily observe that the correct weights are used, without standing near the scales. The composition of the different charges is supplied by the laboratory, which department also fills in the charts which are hung up on a blackboard. On this there are also marked up the number of charges put into the cupolas every hour. Pig-iron is conveyed to charging floor by a conveyor, the scrap and limestone by a crane and the coke from overhead bunkers. These bunkers are

FIG. 2.—CUPOLA CHARGING FLOOR. MESSRS. HENRY FORD & SONS, LIMITED.

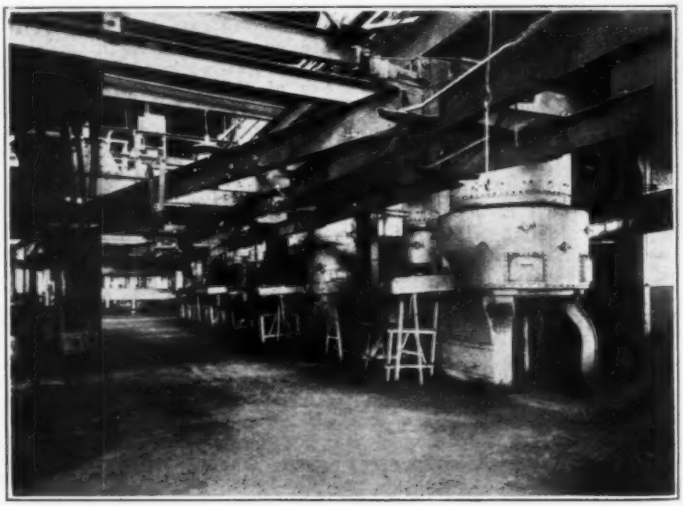


FIG. 3.—SHOWING THE CUPOLA PLANT. THERE ARE SEVEN FURNACES WITH DIAMETERS VARYING FROM 60 TO 42 IN.

filled direct from cargo steamers by a 5-ton transport and grab.

There are seven cupolas (Fig. 3)—three of 60-in., three of 56-in. and one of 42-in. internal diameter and of standard make; they are all fitted with both volume-recording and pressure gauges. Once the blast is put on the furnace, it is run to a determined capacity, and the board on the charging floor should show a regular

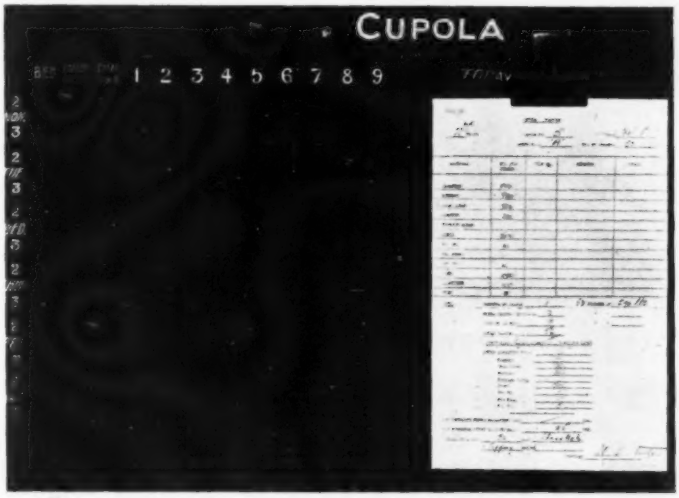


FIG. 4.—A BLACK BOARD SHOWS HOW PRACTICAL WORKING IS RELATED TO THE DAILY CONTROL CHARGE SHEET.

number of charges hourly. This is considered essential if the metal is to be kept within specification and machine-shop expectations are to be fulfilled.

The composition of the iron is specified at T.C. 3.0, Si 3.0, Mn 0.2, S not over 0.1, and P 0.04 per cent. Silicon determinations are made hourly, whilst complete analyses of all metals are made at least once daily. The laboratory controls the temperature at which the metal is poured. The first tap of iron is invariably pigged, together with any surplus, into a pig-casting machine-conveyor, which returns it up to the charging floor. The liquid metal is conveyed by a mono-rail from the cupola spout to the various pouring stations (Fig. 5).

Core Shop.

Core Wash.—The care of all washes is undertaken by one man who mixes and maintains the stocks. Great care is devoted to this particular, because, if the materials are faulty or incorrectly mixed, much trouble will be encountered in the cleaning of the castings. What is desired is a mixture that will dry on the core without cracking, will withstand the wash of the metal, and finally, when mixed, will remain in suspension. All washes are kept agitated when in use; they must conform to certain Baumé numbers, usually 23 or 46, and their correctness is frequently checked by the foreman, as well as the man making the wash. Core wires are cut and bent on automatic wire machines and supplied in bundles to the core makers.

FIG. 5.—OVERMETAL IS POURED INTO A CONVEYOR MADE UP OF CHILL MOULDS, WHICH RETURNS THE RESULTANT PIGS TO THE CHARGING FLOOR.

Sand.

There are in use no less than 14 different mixtures of core sand and three washes. Core sand is mixed on the first floor in four revolving-paddle-type mixers. Sand is first measured into the mixer and oil or other bonding material, such as soluble starch, is added. When mixed it is dumped through a grating in the floor, which feeds a shute terminating immediately above one of the core maker's tables. This is shown in Fig. 6. As far as possible the

Form 131

CUPOLA CHARGES

2nd Shift Cupola No. 5 Date Feb 1st

Grade Iron "A" No. of Charges 53

MATERIAL	WT. PER CHARGE	CHARGES	REMARKS	TOTALS
HEMATITE	Nil			
FOUNDRY	800			
"A" SHOP SCRAP	800			
BORINGS	300			
FOREIGN SCRAP	/			
STEEL	500			
FE. MN.	10			
FE. PHOS.	/			
FE. SI.	10			
COKE	280			
LIMESTONE	100			
FLUX	2			

CONT:- BARROWS IN CHARGE 1 53 CHARGES AT 280 lbs

EXTRA BARROWS IN CHARGE 2

BARROWS IN SHED 11

TOTAL BARROWS 56

FIRST FIVE CHARGES - MORNING AND AFTER LUNCH

ALTER HEMATITE TO:-

Foundry	700
Shop Scrap	900
Borings	300
Foreign Scrap	/
Steel	500
Fe. Mn.	10
Fe. Phos	/
Fe. Si.	5

80% Powdered Ferro Manganese Used / lbs.

50% Powdered Ferro Silicon Used 25 lbs.

Cupola Repairs:- 32 Bags "Plastica"

Tapping Brief /

FOREMAN John L. Sheehan

FIG. 4A.—DETAILS OF THE CHARGE SHEET INDICATED ON FIG. 4.

same men are always retained for the work of sand-mixing.

Particular attention is paid to the green-bond strength of the sand. If the sand is insufficiently or over-mixed the green bond will be weak. A board, with the mixtures painted on it, is hung up in the room for the men to work from, and no one except the executive is allowed to change any mixture. Continuous application enables these men to become expert at this work, and the result is a very uniform mixture of core sands.

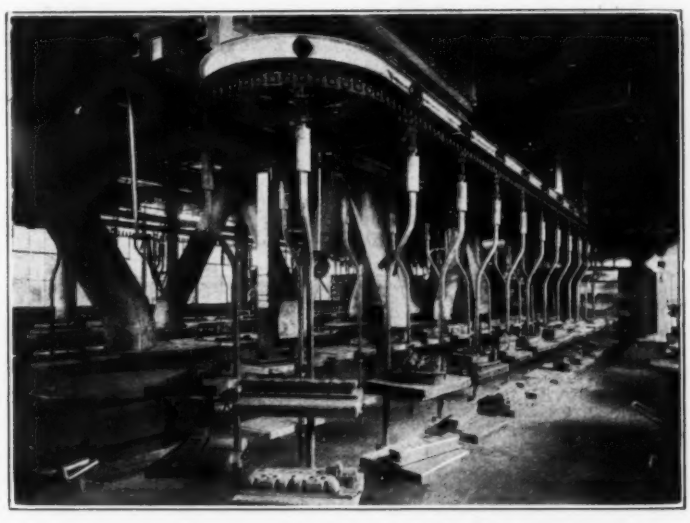


FIG. 6.—CORE SAND, PREPARED ON THE FLOOR ABOVE, IS DELIVERED BY SHUTES TO THE TABLES SHOWN ON THE LEFT. GREEN CORES ARE MADE AND PLACED ON THE PENDULUM CONVEYOR.

Three kinds of sand are used as raw material in the core shop, a sharp sand or sea sand (99 per cent. SiO_2) and bank sand (90 per cent. SiO_2) and a small amount of recovered core sand. A well-selected, properly-mixed core sand will eliminate the use of wires and vents in many types of cores, whilst stripping cleanly from both the core box and the castings, with a consequent increase in production.

A point worth mentioning is that core wires can to a considerable extent be eliminated by the use of a core sand with a high green-bond strength. This type of core sand is readily obtained by the use of a mixture consisting of a soluble starch compound and dextrines. To this is added a small portion of oil. The oil addition, while it adds nothing to the green-bond strength, enables the finished core to be stored more satisfactorily.

Core Boxes.

All core boxes are of metal and accurately machined, as also are the core plates and shell carriers. Wires are used very sparingly and only where necessary; vent wires are used in a very few cores.

Some men complete the boxes by themselves. Other cores are made by a gang working around a circular table. The making of the core is then split up into several operations. Depending on the class of core, the gangs will sometimes comprise three, four or five men to a table. These men just make the core and turn it into drier, where it is stamped with the shift stamp. It is then sprayed or dipped and placed on the green-core conveyor to be stoved. This is shown in Figs. 6 and 7.

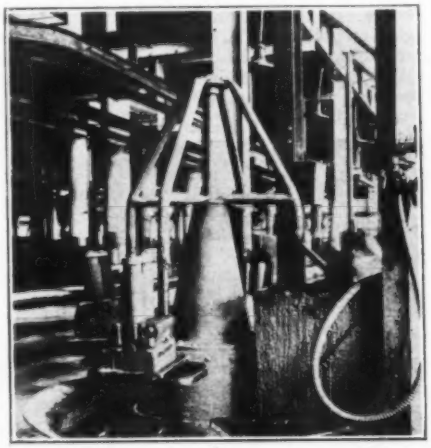


Fig. 7.—Core-Washing Apparatus.

One great advantage of the gang work is that the operations of making complicated cores is split up, and a man very quickly learns to perform the particular operation he is called on to do. It is also easier to instruct a new man, or to replace a man who is away through illness or other cause. Another advantage of gang labour is that a new man working alongside an old hand gets familiar with the real operation, and as a rule becomes proficient quickly when called upon to do so. Further, every man is anxious to get his particular operation on the core finished and passed along to the next operator. Of course, a new hand slows the job up a little until he is competent, or a naturally-slow man will have the same effect, but when he finds the operator behind him is waiting for the core box, and the man in front of him puts his core box up against him, he soon rises to the occasion and is just as keen as the rest of the gang to keep his section of the work moving freely. The last operator places the core on the green-sand conveyor. All cores are checked and production is marked up hourly.

Cores are taken off the green-core conveyor and placed in the core ovens (Fig. 8). Core plates and shell driers, when stripped of cores, are returned to the core makers by the green-core conveyor. The ovens are of the continuous type, heated by gas and are controlled by recording pyrometers.

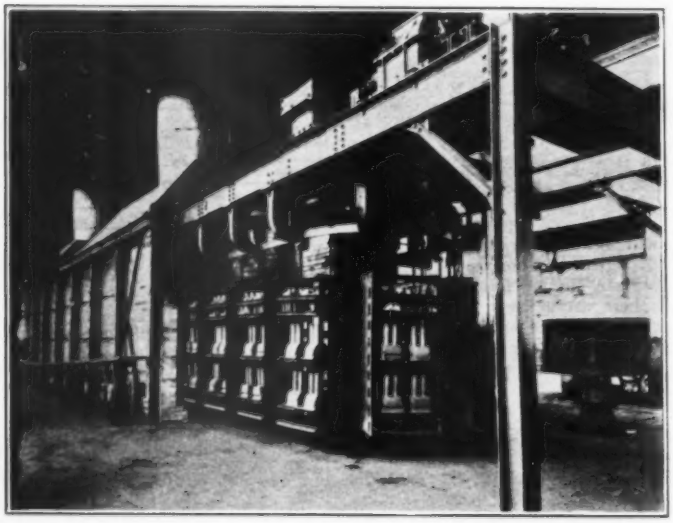


Fig. 8 shows the Continuous Core Oven Used.

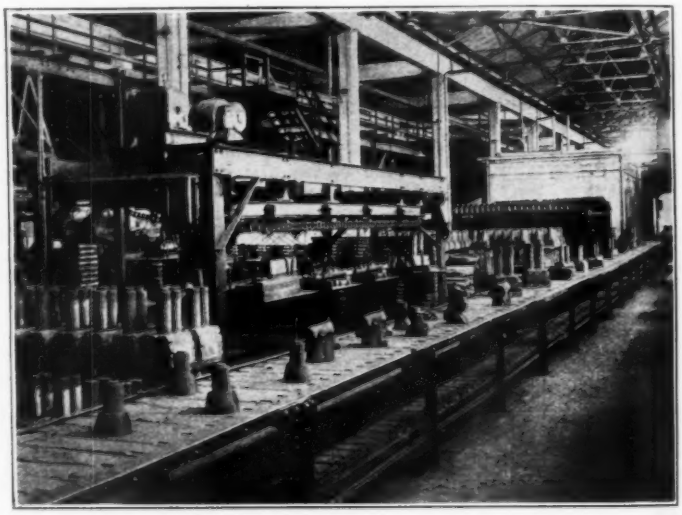


Fig. 9.—The Dried Core Conveyor.

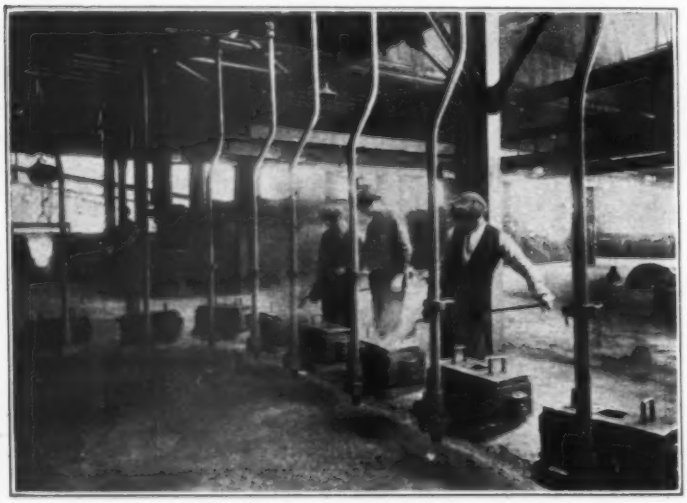


Fig. 10.—A Pendulum Conveyor serving the Pouring Section.

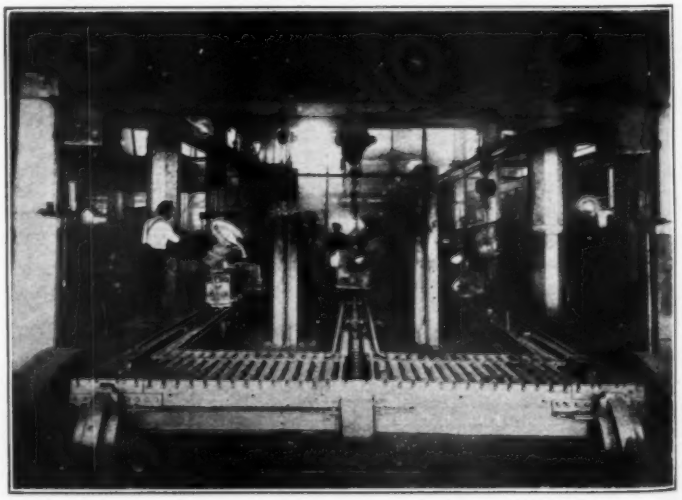


Fig. 11.—For Heavier Moulds a Drag Conveyor is Used for Serving the Casting Section.

Some cores are dipped green in the following manner:—Gear-case cores, together with their plates, are plunged into the wash. Barrel cores are placed on a revolving pendulum-type stand, of which there are four to the machine. The stand is turned through 90 deg. which brings a section over the wash tank shown in Fig. 7. The tank is then lifted by a compressed-air cylinder, and so submerges the core. The tank is now lowered and core is stored in the usual manner. Others are sprayed whilst on the dried-core conveyor, where dry cores are taken from oven and put on the dried-core conveyors leading to the core assembly. In the case of jacket cores, they are rubbed and fitted, assembled and finally inspected and placed on the storage conveyor which also carries the cores to their respective moulding conveyors.

Moulding Floor Systems.

The moulding department consists of a jobbing shop where patterns and the general equipment used in the plant are made; and three conveyor systems—two of the drag and one of the reel type. One of the drag conveyors, on which the large tractor castings are made is equipped with power-jolt rollover machines, and its capacity is upwards of 2,800 moulds in eight hours. It operates as follows:—On the outside of rails which run in the direction of the pouring stations, the drag, or bottom-half of the mould is carried slowly forward, and the men engaged on core-setting, place in the cores and gauge them. By this time, the mould has reached (Fig. 11) the position where the top-half of mould is made and finished ready to close and complete the mould. The mould is then closed, clamped, and heads made up by the time the pouring station is reached, metal is poured and mould is transferred to the centre set of rails which travel in the opposite direction to the outside sets. The moulds are taken down to the shake-out, where a chain conveyor conveys the castings to the cleaning department. The sand is tempered and the flasks are returned to the machines.

One of the features of the conveyor systems is that all operations must be synchronised if the fullest benefits are to be obtained, and one of the most important—if one can be more important than the other—is the pouring station. When the mould has reached this point, the metal must be there ready and waiting. Of course this does not mean too early or else it will become cold and be useless, and if late the conveyor has to wait, which means that production will be impeded, as there is no available room for the moulding operators to place the moulds except on the conveyor.

The Reel System.

The reel system comprises of two pendulum-mould conveyors (Fig. 10) with an accompanying sand system with a capacity of 4,800 moulds in eight hours. The machines used are of hand rollover and power jolt squeeze and strip type.

The method of dealing with the sand is similar to the drag conveyors. The number of men working in a team on the reel is naturally smaller than the drag, usually between 4 and 8, depending upon the type of machines in use. The system operates as follows:—The man working upon the drag makes the mould, rolls it over on a revolving stand, which turns one quarter of a revolution and also brings an empty flask directly to hand. The second man places in a core, if called for, and puts drag half of mould on to the reel. He also places the empty flask on the stand ready for the moulder and has the bottom board handy. The third man makes cope moulds and places them on a similar stand ready for the fourth man, who cleans out runners, completes operation by closing the mould, putting on mould-weight and checks the number made. The mould is then cast and shaken out and flasks are hung on the conveyor. The castings are then inspected and placed on the casting conveyor for transport to the cleaning department.

When the castings have passed the core knock out, they are then loaded in tumbling barrels and tumbled (Fig. 12). They are once more inspected and defective castings are sent to salvage department. Good castings travel on conveyors to be ground (Fig. 13). If they have to be chipped then men with air-chisels standing at each side of conveyor do necessary operations. Castings that require it, have their core wires extracted and are then hydraulically tested and finally inspected.

Scrap.

All scrap that arises during the course of manufacture has to go through salvage department, where it is sorted out and numbered according to a corresponding number on the scrap report for the various defects, and placed in their respective pile and painted. This also includes scrap return from the machine shop for foundry defects. At 10 o'clock each morning all the foremen, having been in possession of their scrap report earlier in the day, meet and examine the scrap pile. Reasons for its existence are agreed upon and the steps to be taken to eliminate the causes are discussed. In addition, the foreman are appraised during the daily operations. For instance, if the inspector at the shake out picks out a defective casting, he immediately acquaints the foreman on the line, and core room foreman and man in charge of pouring the metal are brought together on the job if necessary. Of course, at this stage it is only a rough inspection but its value lies in the fact that in less than ten minutes after the mould is cast, if the casting shows a defect, it is immediately traced to its source. The same system applies when scrap is picked out later, and then the cleaning room foreman does not forget to keep them posted as to how the work is going through so that by the time the daily general inspection of scrap comes, steps have already been taken to remedy the defect. Defective casting that can be salvaged are put through the reheating furnace, welded, and then either passed or finally scrapped. No scrap is accepted on the charging floor unless painted.

A reference to Fig. 1 shows the converging of all operations at the pouring station, and before concluding the Paper we wish again to emphasise the importance of accurate timing at this point. Irregular service from the cupola will mean a shortage of metal or an over supply of metal. The former will hold up the moulding operations, the latter will result in cold iron and mean the pigging of this metal. Irregular production in the moulding will result in the same sequence of effects as an irregularity in the metal supply. As a concluding remark, it seems appropriate to state that never has the adage "Time means Money" been more applicable than in the quantity production of grey iron castings.

[This Paper was presented at the Newcastle meeting of the Institute of British Foundrymen.]

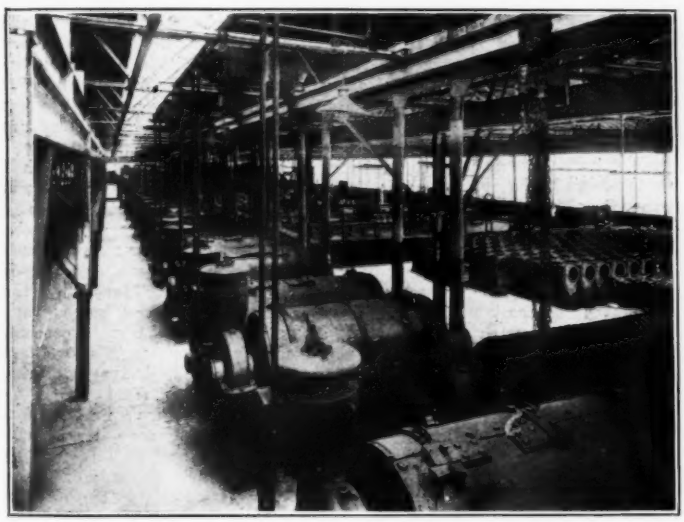


FIG. 12.—TUMBLING BARRELS ARE USED FOR CLEANING QUITE COMPLICATED CASTINGS.

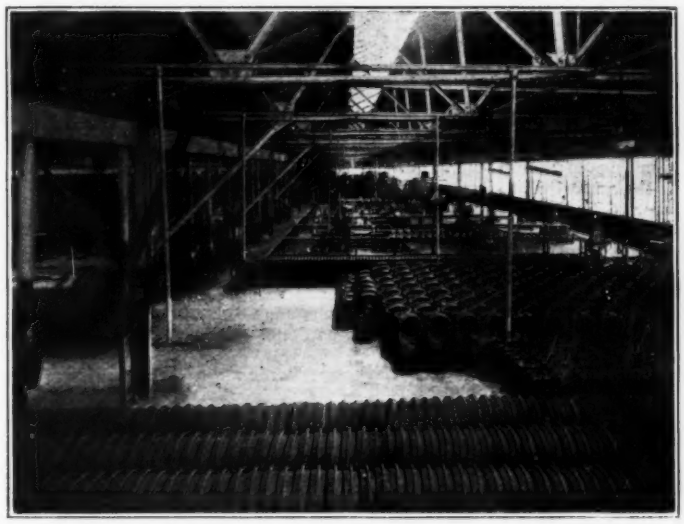


FIG. 13.—AFTER CLEANING ROLLER CONVEYORS ARE USED FOR DESPATCHING THE CASTINGS.

Pinholes in Aluminium Castings.—When magnified, pinholes are found to be of two varieties—round and angular. The former is caused mainly by gas and the latter by shrinkage. When aluminium is poured from a height and allowed to drop into the pouring ladle, it churns air into itself, while metal held at too high a temperature also absorbs gas. Lack of "feed" during solidification causes shrinkage, which is also sometimes due to high iron content. Metal which has been melted in a large furnace and properly fluxed is less liable to give shrinkage trouble than metal of the same composition that has not undergone treatment.—Bulletin A.4 by National Smelting Company, U.S.A.

D

Ferrous and Non-Ferrous Metals in the Foundry.*

By W. Rosenhain, D.Sc., F.R.S.

It is probably because the industry is in the hands of different firms and is carried out in some cases in different districts that a line of demarcation has grown up between ferrous and non-ferrous metallurgy. Whilst I do not fail to recognise the differences which exist between the two branches, I have long felt that the distinction as it stands to-day is arbitrary and not only unjustified but unwise. If we confine our attention to the foundry alone we must realise that the object both of the ferrous and the non-ferrous worker is to produce a sound, strong casting of the desired shape by filling a mould with molten metal. In that one sentence so many points of similarity between the work of the ferrous and non-ferrous foundry have been summarised that it is scarcely necessary to insist further upon the point. In the present Paper I propose to consider the similarities and dissimilarities between the behaviour of ferrous and non-ferrous metals in the foundry, although I cannot hope to make my treatment of the subject by any means exhaustive. The purpose of the comparison which I propose to outline here, however, goes much further than the desire to break down an artificial barrier between "ferrous" and "non-ferrous." My experience of foundries of both types has led me to form the opinion that each has much to learn from the other, for although there are many features peculiar to any particular type of metal or alloy, there are others which relate essentially to the handling of liquid metal which apply equally to the majority of alloys. It is surprising, therefore, to find that in practice there is at present very little interchange of knowledge and experience between the ferrous and non-ferrous branches of the industry, so that there appears to be much room for the worker in each field to learn from the other how both things may be done well and how they should not be done.

Differences in Non-Ferrous and Ferrous Practice.

Perhaps it will be as well at the outset to analyse the *differences* between ferrous and non-ferrous metals in order that we may better appreciate those problems which are common to both.

Probably the most important difference, at all events between cast iron and the non-ferrous metals, is the relatively low price of the former. At first sight this would appear to be purely a commercial question, but on examination it proves to be a very important factor. To take one point only, metal losses in the non-ferrous industries are a matter of serious importance and the methods of melting particularly are rightly designed to minimise such losses. On the contrary, in the case of cast iron the cost of melting both in regard to fuel, capital cost of furnace, labour and other charges becomes a much more serious item in relation to the cost of the finished casting. The consequence has been that in the majority of cases the cheapest and simplest type of melting furnace has been employed for cast iron with comparatively little regard for metal losses and, I fear, in some instances no very great regard for the quality of the resulting product. I am quite aware that perfectly satisfactory cast iron of high quality can be made cheaply and well in a properly designed and operated cupola furnace and, in fact, I understand that in America the use of a furnace of that type for brass melting on a large scale has been attempted. On the other hand, the electric furnace of the cored-induction type has made great progress in the brass industry and may be destined ultimately to replace all fuel-fired furnaces for that purpose. For cast iron, on the other hand, although an electric-arc furnace has been used in a few foundries and the use of the high-frequency induction furnace is now being suggested tentatively, the melting costs in these furnaces as compared with a cupola are so high and are so important a factor in the price of the finished product that it seems very doubtful whether electric melting can make the same headway in the cast-iron industry as it is doing in connection with the non-ferrous metals.

The Case of Steel.

If, under the heading of ferrous metals, we include, as we must, steel, we meet with a very different picture. Here the value of the product is higher and the attainment of satisfactory quality both more important and much more difficult. It is not too much to say that at the present day the production of thoroughly sound steel castings of all desired sizes and shapes is an art which is neither widely known or practised, although the fine achievements of some steel foundries demonstrate that it is commercially possible. The fact that steel requires a temperature so much higher than that needed for the melting and casting of cast iron and of the great majority of non-ferrous metals not only adds to the difficulties of the founder but requires melting furnaces of a high order of efficiency. Here, again, the electric furnace, in the first place the arc furnace and more recently the high-frequency induction furnace, have made great progress, and at least an appreciable proportion of the world's output of steel castings is electrically melted. It would be interesting to analyse in greater detail the reasons why electric melting has made and is making so much progress in connection with steel and non-ferrous alloys and comparatively so little in cast iron, but the rough outline of the principal factors given above must suffice for the present purpose.

Temperature Differences.

The differences in the temperature of the molten metal which is poured into the mould bring with them corresponding differences in the moulds themselves, whilst there is also another factor which differentiates steel in particular and also iron from the majority of non-ferrous metals, and that is the susceptibility of the former to chilling effects. It is probably not too much to say that in the great majority of non-ferrous metals the more rapidly the casting can be cooled the better the result, provided that cracking or warping do not occur. This probably also applies to castings of very mild steel, but it does not apply to a great many varieties of cast iron and to some of the harder grades of steel. Where the metal becomes hardened by chilling, either from the liquid state or by subsequent rapid cooling, a limitation is put upon the use of metal and more especially of water-cooled moulds. Some cast-iron castings are none the less made in "permanent" moulds, but I believe that in the majority of such cases the iron mould is coated with a thick dressing of a relatively poor conductor of heat. In the majority of non-ferrous metals no such thermal insulation is necessary, and the use of chill moulds is only limited by the fact that for the more complicated shapes they are difficult and expensive to produce and are apt in certain cases to require comparatively complicated mechanism to allow of the ready removal of the casting and to give it freedom to contract during cooling without stress or rupture. The use of metallic moulds, however, is subject to yet another limitation, especially where metals of high melting point are concerned, more especially if they are capable in the liquid state of dissolving or reducing the oxide coatings which normally protect the surfaces of metal moulds. A stream of very hot metal impinging upon the wall of a metallic mould is apt, first to cut away the dressing which has been applied, then to remove the natural oxide skin and to attack the metal of the mould itself, with the result that both mould and casting are damaged. Where molten steel has to be handled this is a very serious difficulty and has contributed largely to the fact that chill moulds are rarely employed in the steel foundry. The phenomenon, however, is not peculiar to steel, but may be encountered with many of the higher melting alloys of copper and of nickel.

The Rôle of Metallic Moulds.

If we turn from the rather special case of the metallic mould to the very general one of the sand or refractory mould we find that there is little difference in principle between the moulds and moulding materials used for cast iron and most non-ferrous metals, but that steel presents very special difficulties owing to the high temperature of the molten metal. Many of the moulding sands which are successfully employed for cast iron or for non-ferrous work are useless for steel because they are not sufficiently refractory. If fusion or softening takes place the mould itself may be destroyed or at least quantities of the surface sand become firmly attached to or even slightly embedded in the steel itself, leading to a highly unsatisfactory state of the casting with which steel founders are unpleasantly familiar. Moulding sands for steel, therefore, present problems which do not appear where metals of lower melting point are employed.

In addition to the broad differences which I have outlined above there are a number of others applicable to individual material rather than to the ferrous and non-ferrous metals as a whole. For instance, some metals fill their moulds much more rapidly and easily than others, and that is in some cases ascribable to the fact that the metal undergoes an expansion at some stage either during solidification or subsequent cooling, while, on the contrary, other metals contract seriously and continuously. The influence of gas, present in the molten metal and liable to separate from it during freezing, is very important in this connection and may in fact not only mask, but completely outweigh, any physical changes which the metal itself undergoes. Here there is probably no fundamental difference between iron and the non-ferrous metals, but, up to the present, the function of gases in cast iron does not appear to have received the same amount of attention as has been given to it in recent years by non-ferrous metallurgists.

Sands for Moulding.

If we take in order the various processes involved in the production of a casting we shall see, from point to point, both the similarities and differences between ferrous and non-ferrous materials. Some reference has already been made to the question of moulds, but rather from the point of view of emphasising the differences between the two types of practice. On the other hand, it must be recognised that the moulds used for iron and even for steel have, on the whole, more points of resemblance with those of the non-ferrous foundry than they have points of difference. It is true that sands ordinarily used for making either green-sand or dry-sand moulds for iron and for non-ferrous purposes are different, and it would be interesting to discover the precise basis upon which these differences have arisen. I should not be surprised to find that the origin of varying practice lies largely in geographical conditions. Foundries naturally employ a sand which is conveniently situated, and although methods of studying and testing moulding sands have been developed and are gradually coming into wider use, there can be no doubt that in a great many instances the particular sand employed is a matter of tra-

* A Paper read before the Newcastle Meeting of the Institute of British Foundrymen.

ditional practice rather than of any rational choice. Experiments which I have had the opportunity of observing have shown that there is often very little difference between moulding sands derived from widely-different sources and respectively recommended for iron and for non-ferrous metals. Requirements of sufficient bonding power and of adequate permeability to gas are common to both, and the temperatures to which the sand is exposed do not differ so widely as to affect the choice of the material to any great extent. There is, however, one feature which differentiates much of the practice of cast-iron moulding from that of the non-ferrous foundry. This is the use of a certain proportion of coal dust in certain portions of the moulding sand of the iron foundry. This is not usual for non-ferrous castings, and I doubt whether it would lead to success. On the contrary, I have seen iron castings successfully made in moulding sand entirely free from this ingredient. We have here an interesting point of difference which it should be worth while to investigate in order to ascertain whether it rests upon a sound foundation or is purely traditional. It might, at first sight, be supposed that since cast iron already contains a considerable proportion of carbon the presence of carbon in the moulding material may be desirable or at all events harmless. I have heard it suggested that the presence of the carbon in the moulding sand tends to lessen surface oxidation and decarburisation of the castings, while others claim that a combustible ingredient serves to increase the permeability of porosity of the mould.

"Flaming" Mould Dressings.

These considerations lead naturally to the subject of mould dressings and core binders. With regard to mould dressings, it is, I believe, widely thought that a so-called "flaming" dressing, which is supposed to fill a mould with reducing gas, is advantageous, both for iron and non-ferrous metals. There can be no doubt that it is highly desirable to protect the stream of molten metal, whether ferrous or non-ferrous, from oxidation during the filling of the mould. Especially where the filling process is slow and the metal enters in a comparatively thin stream, such surface oxidation may become seriously injurious. In the case of steel, it is well known that the oxides formed upon the surface during pouring react with manganese and silicon present in the metal to produce non-metallic enclosures which have no time to rise through the liquid steel in the mould and are present in the finished material. Their presence in steel, whether cast or wrought, is highly undesirable. If it were possible to protect the molten steel throughout the whole of its passage from furnace to mould against contact with atmospheric oxygen a very decided advantage would be gained and the same applies, although perhaps to a lesser degree, to cast iron and to the non-ferrous metals. The difficulty arises, however, of carrying out such protection effectively.

In some foundries devices have been tried of causing a stream of molten metal to flow through a tube instead of an open channel or nozzle and to pass through this tube above the molten metal a current of inert or reducing gas. Unfortunately, this entails cumbersome appliances and is not readily applicable to the feeding of the mould from a ladle or crucible. The use of a "flaming" dressing is believed to furnish some protection, but I venture to doubt its efficiency. In the first place the "flaming" dressing may influence the composition of the gases present in the mould when the metal enters it, but it can scarcely protect the stream of metal before it enters the mould. Not only this, but the atmosphere produced by a "flaming" dressing is not necessarily of an adequately protective nature. It is a curious feature that metals still take up oxygen from an atmosphere containing only a small percentage of that gas or even of water vapour, in spite of the presence of considerably larger quantities of such gases as carbon monoxide or hydrocarbons. Further, the presence of de-oxidising gases prevents the formation of scale or oxide scum on the surface of the metal; yet this scale or scum acts as a definitely retarding agent upon further oxidation, and when its formation is prevented any oxygen which is present in the atmosphere is free to attack the metal with the resulting solution of the oxide in the liquid. It is therefore a matter of doubt whether a really oxidising atmosphere such as air may not be better from the view point of the total oxygen content of the resulting casting than an atmosphere rendered partially reducing by a "flaming" dressing. In regard to the decarburisation of steel in re-heating or annealing furnaces it has clearly been shown that unless an atmosphere can be kept entirely free from oxygen and water vapour there is less decarburisation when the surface is allowed to scale in an atmosphere of air, than when it is kept comparatively clean in a "reducing" atmosphere.

Dangers from "Flaming" Mould Dressings.

Quite apart, however, from this question of oxidation the presence of a "flaming" dressing in a mould appears to me to have certain disadvantages. These arise from the fact that the dressing is not immediately decomposed when the molten metal comes in contact with it. The result is that the decomposition of the dressing under the action of heat continues well below the surface of the metal in the mould with the result that the gases given off have to find their way upwards either through the liquid metal or through the pores or vents of the mould itself. In many cases this is satisfactorily accomplished but where there are inequalities of shape there is sometimes a tendency for gas bubbles to be trapped and to give rise to unsoundness. In the case of chill moulds where there is no escape for gases except through the metal itself and where solidification near the surface of the mould commences very soon, the risk of trapping gases derived from mould dressings of this type is very considerable. These matters, however, certainly require much further study both in the foundry and by carefully designed experiments in suitably equipped laboratories. The only reason for insisting upon them here is to show that they constitute a problem common to ferrous and non-ferrous foundry practice.

Core Binders.

The question of core binders is to some extent of a similar nature. For many non-ferrous castings cores are made of baked loamy sand, whereas for iron, it is more general to employ cores of a non-bonding sand held together by an organic binder which decomposes as soon as the core is heated sufficiently by contact with the molten metal in the mould. A core which disintegrates spontaneously within the casting as soon as the latter has begun to set is undoubtedly advantageous, and the more so the greater the contraction of the casting during cooling. An unyielding core is very liable to cause cracking of the casting under contraction, and many devices have been employed to afford an easy means of yielding in the core. It is a curious anomaly, however, that in the practice of the non-ferrous foundry, where metals are handled which generally show a much greater contraction than cast iron, baked loam cores of a relatively unyielding character are frequently employed as compared with the disintegrating cores customary in ironfounding. This appears to be a point where exchange of knowledge and experience between the foundrymen engaged in different branches would be highly advantageous to both. Problems of ferrous and non-ferrous melting offer many other points of interest from a comparative point of view. Such questions as the "head" under which the metal is cast in the moulds, the size, shape and location of gates and risers, and many other points, naturally occur to one, but it would occupy too much space to analyse these in detail.

Running Desiderata.

Really useful comparisons could only be made by detailed examination of the work done in foundries of different types, preferably by men expert in other branches of melting. The differences in the physical properties of the molten metals may perhaps play a part in determining the best methods of causing them so as to enter into and fill a mould in the most satisfactory way. For instance, with some metals it would be undesirable to allow two streams passing into the mould in different directions to meet at any considerable distance from the pouring gate, since the formation of an oxide film on the surface of each stream might easily prevent satisfactory joining, so that a "cold shut" would result. With other metals where the oxide skin is not tough there need be no misgivings on such a point. Similar considerations apply to the actual manner of pouring the metal. In some materials it is essential to secure as steady a stream in filling the mould as can possibly be arranged, since every surge and ripple is apt to leave marks of greater or lesser depth upon the surface. An outstanding example of the advantages of filling a mould as steadily and smoothly as possible is furnished by the well-known Durville process for casting alloys of copper containing certain proportions of aluminium, which give somewhat unsatisfactory billets if cast into ingot moulds in the ordinary manner, but yield the smoothest possible surface when the metal is slowly tilted into the mould by the Durville apparatus. Yet with brass not containing aluminium, the Durville method is by no means satisfactory. Such questions as the advisability of pouring the metal over the lip of a ladle or of allowing it to run through a plug-hole in the bottom of the ladle, raise somewhat similar, although different, problems.

The manner in which the metal is brought to the mould and poured into it must naturally affect the design of gates and risers, while the question of gas content and the evolution of gases from the solidifying metal introduces another factor. To some extent, no doubt, existing practice, having been arrived at by a slow process of trial and error, takes into account these difficulties. Our knowledge of these things, however, has advanced so much in recent years that the time has come when the various factors determining the production of a successful casting can be more fully analysed and improvements upon existing methods developed. It is, in fact, only when we begin to understand why we do things in the foundry that we shall really do them better and more successfully than we have done in the past.

Permanent Moulds.

The use of "permanent" moulds for both ferrous and non-ferrous castings has already been mentioned, but the processes of die casting have also to be considered in their relation to both types of material. In non-ferrous alloys die casting proper, that is to say, casting in "permanent" moulds under pressure, has developed in recent years to a great extent, and remarkably good products are obtainable by these methods, which in many cases have opened up new uses for various alloys. Hitherto, pressure die casting has been mainly applied to metals of relatively low melting-point, although brass and bronze have in recent years been brought into its scope. The possibility of utilising the process for the casting of ferrous materials, both cast iron and steel, is probably worthy of consideration in the near future. I believe that some attempts in that direction have already been made but there are obviously serious difficulties to be overcome owing mainly to the high temperature of the molten metal, especially in the case of steel, and to the severe chilling effect which would be experienced with cast iron. We have seen in recent years, however, such marked progress in technique by which difficulties at least

as formidable as these have been overcome that I should be surprised if the problem of die-casting ferrous materials should prove an exception. Possibly the development of the relatively new and hard metals consisting mainly of carbides may render possible the production of dies which will withstand even molten steel. The containers and other appliances required for injecting the molten metal under pressure also present serious problems, and there is also the difficulty of keeping the molten metal sufficiently hot up to the moment when it enters the actual die. Here, however, modern electrical methods, thanks to their great flexibility and adaptability, may help to find a satisfactory solution. Although I mention this matter very briefly, it leads to another consideration which is of general importance both to the ferrous and to the non-ferrous founder. This is the question of the selection of the right material for any particular purpose and the competition which exists between different types of material. There are comparatively few applications at the present time where cast iron and non-ferrous castings stand in direct competition; where they do, the result is probably in the end beneficial to both, since it is only by closer adaptation both of the properties of the finished material and of the methods of production to specific requirements that success in competition of this kind can be achieved. These are things that make for general progress in both branches of the industry.

Corrosion of Cast Alloys.

A great factor in this connection lies in the increasing attention which is being given at the present time to the whole problem of corrosion. In the past it has been customary to employ the more expensive non-ferrous materials either because of appearance, facility of working, or special physical properties or because greater resistance to corrosion was required than was supposed to be obtainable with cast iron. The corrosion problem, however, is becoming increasingly important in the eyes of the users of metals and both branches of the industry are called upon to undertake developments which will meet this somewhat changed viewpoint. Here again there is some rivalry between the ferrous and the non-ferrous branches as, for example, between such things as domestic fittings cast in rust-resisting steel or those in brass or bronze with or without the protection of chromium plating. From the immediate point of view of this Paper, however, the important point is that requirements of the kind just referred to will unavoidably impose upon the founder difficulties of a nature which he could hitherto avoid to a large extent. The tendency to use an alloy or an iron of a particular character on the ground that it is easy to cast is familiar to all who are connected with the founding industry. The more stringent requirements in regard to chemical and physical properties which already exist to-day and which are certain to be insisted upon to an increasing extent in the future, must restrict such a choice and thereby increase the technical difficulties which both ferrous and non-ferrous foundrymen have to overcome. This consideration strengthens the argument which lies at the root of the present Paper that collaboration of those working in all branches of the founding industry is highly necessary if they are to hold their own.

Competition from Forged Material.

This point is further emphasised by the competition which exists to-day between castings and parts manufactured from wrought materials whether ferrous or non-ferrous. The competition between certain types of large castings and equivalent structures fabricated by welding from rolled steel is familiar to the industry. In other directions there is a similar competition between stampings and pressings made from sheet material and castings, more especially die castings. The matter affects practically every branch of the founding industry, a striking example being the use in certain instances of cast-steel crank shafts for large engines in place of the forged shafts which are customary. The fact that such a use is possible serves to show that if the resources of the foundry are fully exploited by the application of scientific metallurgical methods combined with the best practical experience, there are fields open to the products which at the present time are scarcely touched. There is as yet a much higher degree of confidence, where highly-stressed parts are concerned, in wrought material, but there is little or no inherent reason why a thoroughly sound and properly heat-treated casting should not attain physical properties quite comparable with those of wrought material. It would, however, be necessary to improve the uniformity and complete soundness of castings, and above all their continued reliability, far beyond the level yet attained in most commercial foundries before the entire confidence of the engineer could be won. This may be a distant ideal, but it is one towards which both the ferrous and the non-ferrous founder should endeavour to work, and they will progress the better if they work together.

Inspection of Castings.

When the casting has been taken from the mould, it has yet to undergo further processes and operations which, again, in their essence are entirely similar whatever the material of the casting. Apart from cleaning and fettling, the most important are inspection and testing. In regard to inspection, there is no appreciable difference either in the methods available or the purposes to be served as between ferrous and non-ferrous castings. Where the parts in question have to meet stringent specifications or where they are to be subjected to expensive machining processes, the most careful and exhaustive inspection is desirable, as much from the point of view of the foundry as from that of the purchaser. To have castings returned, after they have been passed by an insufficiently searching inspection, because on machining they have proved seriously defective, is almost as bad for the foundry as it is for the user who has wasted money on the earlier stages of machining. Unfortunately, it is not always possible to detect cavities or other defects if these happen to be hidden by the skin of the casting, but there are many modern methods by which such defects can be traced. Some of these, such as examination by X-rays, are probably too expensive and elaborate to be used for routine purposes. They have been used very effectively, however, as a means of ascertaining whether the method of making a casting, which has been adopted in a given case, is satisfactory. For this purpose it is only necessary to take a few samples from a batch of castings and to examine them thoroughly by means of X-rays. The occurrence of particular types of defects can usually be recognised quite readily, and they can then be eliminated by modification of the methods of pouring, gating, feeding, etc. This use of X-ray examination for the purpose of arriving at a thoroughly satisfactory method of production before large quantities of any novel type of casting are turned out has proved highly satisfactory in a number of foundries, both ferrous and non-ferrous. There are probably many foundries of both branches where the installation of an X-ray outfit sufficiently powerful for this purpose would be difficult both on grounds of expense and of the skilled technique required for its use. This would seem to be one example where co-operative effort is desirable, and the existing Research Associations which respectively cover the ferrous and the non-ferrous field should provide the necessary facilities. Possibly one outfit for both branches of the founding industry would be sufficient for some time.

Sampling and Testing.

The subject of the sampling and testing of castings is a very large and important one, but I have dealt with it recently elsewhere and do not propose to go into details here. It is a matter which, moreover, concerns the user perhaps even more than the foundrymen and is, therefore, best discussed where the maker and the user as well as the expert in testing methods meet on common ground, as they did, for example, at the recent discussion of this subject at the Institute of Metals in London. From the foundryman's point of view, however, I would say that the establishment of the most satisfactory method of testing is highly desirable even if at first sight new methods might appear more searching and more difficult to meet. The point which I wish to emphasise is that a thoroughly sound method of testing is eminently desirable from the maker's point of view because in the first place, it gives the advantage to the better man—that is to say, to the founder who is able to turn out really satisfactory material. To those who are not as yet so fortunate as to be able to do this, a sound testing technique provides the only means of improving their product and so enabling them to compete on equal terms with rivals who may be at the moment in advance of their practice.

Manufacturers, whether of castings or other materials, must realise that at the present time the conditions under which materials are produced and used are very different from those which were in vogue some years ago. The user possesses to-day a much better understanding both of the requirements which he may expect his materials to meet and of the methods of testing which are available. The result is that it is becoming increasingly difficult to sell materials on name or reputation and that compliance with searching specifications has to be achieved. The existing severe industrial depression has intensified this attitude on the part of the user who cannot afford to take into his shops anything that may not turn out satisfactory. At the same time the increased knowledge of the properties of materials and of testing methods has rendered these more rational and better adapted both to what the material can furnish and what the engineer really requires. The less the user knows of the properties and possibilities of a material the more likely is he to impose conditions of purchase which are unreasonable and unnecessary. Greater knowledge and greater control makes it possible in many instances to restrict specification requirements to a smaller number of essential points, although the insistence upon these becomes proportionately greater.

These are, of course, factors which apply equally to ferrous and non-ferrous materials, and it is, therefore, all the more surprising to find that there are appreciable differences in testing practice between the two branches of the industry, differences not essentially due to the varying physical properties of the materials. It is surprising on consideration to find, for instance, that whereas the transverse bending test is familiar and regularly used throughout the ironfounding industry, it is practically unknown in non-ferrous practice at the present time. Where highly-ductile materials are concerned this is, of course, natural, since the bending test does not lend itself to materials of that type. There are, however, many non-ferrous casting alloys, particularly certain of the light alloys of aluminium, in which the degree of ductility is not very much greater than that of grey cast iron, and yet the attempt is made to measure their ductility in terms of elongation in a tensile test. The objection has been raised that the greater elasticity (lower elastic modulus) of the light alloys would interfere with the bending test because of the relatively larger amount of elastic deflection. It is, however, not at all difficult to calculate the amount of elastic deflection which a beam of given span and dimensions will give under a known load, and this can easily be tabulated and deducted from any measured deflections taken in a test.

(*Concluded on page* 358.)

S&L

PIG IRON

WE PRODUCE

IN NORTHAMPTONSHIRE
LLOYDS and ISLIP Brands

IN STAFFORDSHIRE
S.V.H. Brand

In suitable qualities for the manufacture of: HIGH CLASS ENGINEERING CASTINGS, MOTOR CYLINDERS, LIGHT CASTINGS, RAINWATER GOODS, BATHS, RANGES, GRATES, STOVES, HOLLOW WARE and all FOUNDRY PURPOSES.

We also make Forge Iron for Wrought Iron Makers and Basic Iron for Steel Works use.

RANGE OF ANALYSIS

SILICON : ·50% to 5%
SULPHUR : trace to ·10%
MANGANESE : ·30% to 4%
PHOSPHORUS : ·50% and upwards

PROPRIETORS OF LOWICK GANISTER
AS USED BY THE LEADING IRON FOUNDERS.

STEWARTS AND LLOYDS LTD

SALES OFFICE : **BROAD STREET CHAMBERS, BIRMINGHAM.**
LONDON OFFICE : **WINCHESTER HOUSE, OLD BROAD STREET, LONDON, E.C.2.**
CARDIFF OFFICE : **HANNAH STREET, DOCKS.**

This Week's News in Brief.

Trade Talk.

Messrs. William Jacks & Company have removed their Glasgow office from 19, St. Vincent Place, to Central Chambers, 93, Hope Street, Glasgow, C.2.

The exports of coal (exclusive of bunkers) from the Elizabeth Dock, Maryport, to Irish ports last month amounted to 6,950 tons, against 8,465 tons in April and 10,195 tons in May, 1931.

Messrs. Brown, Lenox & Company (London), Limited, have received an order from the Iraq Petroleum Company, Limited, for 42 storage tanks in connection with developments which they have in hand.

The staff of the Coltness Iron Company, Limited, Newmains, held their annual outing on May 28. A large party travelled *via* Glasgow to Gourock, where the steamer "King George V" was boarded. The party cruised through the Lochs, Kyles of Bute and Arran back to Gourock.

An extraordinary general meeting of Messrs. Cammell, Laird & Company, Limited, held at Birkenhead on May 31, approved a resolution converting £957,429 5s. fully-paid ordinary stock created under the reorganisation scheme into 3,829,717 ordinary shares of 5s. each.

Scammell Lorries, Limited, have secured an order for the special vehicles required for pipe conveyance on the new pipe line of the Iraq Petroleum Company. The vehicles will be 10-wheeled flexible machines capable of carrying 10 tons of steel tubes up to 40 ft. or 50 ft. in length.

Owing to the extension of their business, Messrs. Robson Refractories, Limited, 16, North Road, Darlington, have found it necessary to move to larger premises at 47, Coniscliffe Road, Darlington. The firm's telegraphic address is "Cupoline, Darlington," and their new telephone number is Darlington 2441.

The Fairfield Shipbuilding & Engineering Company, Limited, Glasgow, launched the last vessel they have under construction, H.M.S. "Delight," a "D" class torpedo-boat-destroyer and a sister-ship to the "Dainty," which was launched last month. The vessel has a displacement of 1,375 tons, and was launched without the usual ceremony in the presence of a few officials of the Admiralty.

Messrs. Lobnitz & Company, Limited, Renfrew, have launched the twin-screw tug "Awarua" for the Bluff Harbour Board, New Zealand. The vessel has a length of 130 ft., designed for a speed of 12 knots and a pull equal to 12 tons on the tow rope. It will be the most powerful tug operating in the Far-Southern Hemisphere, and is fitted with all the most modern types of windlass and winches.

Messrs. Alexander Stephens & Sons, Limited, Linthouse, Glasgow, have launched the shelter-deck cargo steamer "Gazcon," which has been built to the order of Cie de Navigation d'Orbigny, of Paris. The vessel is 395 ft. between perpendiculars, with a beam of 53 ft. and of 4,200 gross tonnage, built under the supervision of Messrs. Joseph Kose & Son, of Glasgow, to Lloyd's rules. The propelling machinery consists of triple-expansion reciprocating engines supplied by the builders.

Applications for increased duties have been made to the Import Duties Advisory Committee by the British Hacksaw Makers' Association, in respect of hacksaws, and by the British Safety Razor and Blade Manufacturers' Association, in respect of razor blades. Any representations which it is desired to make in regard to these articles should be addressed in writing to the Secretary of the Import Duties Advisory Committee, Caxton House (West Block), Tothill Street, London, S.W.1, not later than June 20.

Wild-Barfield Electric Furnaces, Limited, Elecfurn Works, North Road, Holloway, London, N.7, inform us that the Telegraph Construction & Maintenance Company, Limited, of Wharf Road, City Road, and Greenwich, have entered into an arrangement with Wild-Barfield Electric Furnaces, Limited, whereby the latter will act as sole wholesale distributors of the following electric resistance alloys:—"Pyromic," 80/20 nickel chromium, for temperatures up to 1,150 deg. C.; and "Calomic," nickel-chromium iron, for temperatures up to 1,000 deg. C. These alloys, which are supplied in rod, wire, strip and sheet, are induction melted in the latest type of electric induction melting furnaces, this method of manufacture eliminating all impurities.

Obituary.

We regret to announce the death of Mr. John Lynn, chairman of John Lynn & Company, Limited, Pallion, Sunderland, which occurred on Friday, June 3, at his residence, 29, Thornhill Terrace, Sunderland.

Mr. Leonard Norman Barrow, a director of the Staveley Coal & Iron Company, Limited, and of the Yorkshire Main Colliery Company (1923), Limited, has died in a Nottingham nursing home. His great-uncle owned the Staveley Works until 1863, when the Staveley Company was formed.

Mr. Charles Heaton, joint managing director of Messrs. William Hunt & Sons, the Brades, Limited, Brades Steelworks, Birmingham, died on Sunday, May 29. Born in 1864, Mr. Heaton was educated at Clifton College, and joined his father and two brothers in the firm of William Hunt & Sons.

Mr. George Nicol M'Lachlan, a partner in the firm of Paul & M'Lachlan, Carronbank Foundry, Denny, died at the residence of his sister-in-law in Wallasey on May 28. Mr. M'Lachlan, who was in his 50th year, had been in indifferent health for some time and had been unable to take an active part in the business for the past twelve months.

Mr. Peter Deward Ewing, C.B.E., managing director of Messrs. J. Samuel White & Company, Limited, who died on June 1, was well known in Clyde shipbuilding circles. He served his apprenticeship with Messrs. Aiken & Mansel, Whiteinch, Glasgow, and later was employed in the yard of Messrs. J. & G. Thomson, Clydebank. He then became manager of the Ardrossan Dockyard, and from 1910 to 1915 he was general manager of Messrs. the Ailsa Shipbuilding Company, Limited, Troon. In 1915 he went to Chepstow to lay out the yard for war needs and finally became general manager of the Cowes yard. He died suddenly in a Glasgow home, and was 66 years of age.

By singular coincidence, the two oldest foundry owners of the North-East passed away at the week-end within a few hours of each other, and both had been intimate friends for upwards of half-a-century. Mr. John Lynn, founder of the firm of John Lynn & Company, Limited, engineers and iron-founders, of Pallion Forge, Sunderland, had reached the venerable age of 86, and only relinquished active work a couple of years ago. He was a familiar figure in Northern industrial circles, and in the boon period that followed the war his firm fulfilled foundry contracts for most of the shipbuilding yards on the Tyne and Wear. One son survives him, together with a sister, Lady Marr, wife of Sir James Marr, the well-known Sunderland shipbuilder.

Mr. Michael Aynsley, head of the firm of Messrs. M. Aynsley & Sons, Limited, of Heber Tower Ironworks, was in his 88th year, and his wife, aged 85, survives him, the couple celebrating their diamond wedding in January, 1929. He was a native of the Tyneside city, and started work with a local chemist when ten years of age. Later he became apprenticed with Messrs. Walker & Emley, and after serving his time, purchased, in partnership with Mr. James Rennie, the works founded in 1750 by Messrs. Elliott in Low Friar Street. Years later, when the partnership was dissolved and the premises sold, he began business on his own account as a foundryman in Monk Square, later moving to Stowell Street and then to the Heber Tower Works, where he built up an extensive connection.

The death occurred suddenly at his home in Barrhead, Renfrewshire, on May 28, of Mr. Tom Bell, one of the original members and a Past-President of the Scottish Branch of the Institute of British Foundrymen. Mr. Bell, who was in his 65th year, had had a wide and varied experience of foundry work in England, as well as in Scotland. He had been in poor health for some time, and retired from the position of foundry manager to Messrs. James Howden & Company, Limited, Glasgow, about two years ago for health reasons. He was an enthusiastic member of the Scottish Branch and keenly interested in all that pertained to the foundry. The Branch was represented at the funeral, which took place at Neilston Cemetery, Barrhead, on May 31, by Messrs. Campion and Winterton, Past-Presidents, and Mr. John Bell, hon. secretary.

Personal.

Mr. E. J. Fox, managing director of the Stanton Ironworks Company, Limited, has been elected chairman of the Council of the Society of British Gas Industries for the coming year.

Mr. Thomas Williams, late works manager, has received a presentation from the directors, officials and staff of the South Durham Steel & Iron Company, Limited, on his retirement after 33 years' service.

Mr. John Webster was presented with a cheque from the senior officials of the Corporation of Glasgow on the occasion of his retirement from the managership of the Provan Gasworks. Mr. Webster, who has completed 50 years' association with the Scottish gas industry, served his apprenticeship at Durie Foundry, Leven, Fife. He early on showed marked interest in the manufacture of gasworks plant and considerable ingenuity in designing plant for the industry. He was appointed manager of the Provan works when it was opened in 1904.

Mr. Arthur Jackson, President of the Arthur Jackson Machine Tool Company, Toronto, Canada, has the intention of visiting Great Britain and the Continent towards the end of July, or beginning of August for a few weeks. Mr. Jackson will be accompanied by Mrs. Jackson, and the real object of his visit is to get into touch with manufacturers of up-to-date machine tools, etc., suitable for the Canadian market. His headquarters will be at the offices of the Universal System of Machine Moulding & Machinery Company, Limited, 13-15, Wilson Street, London, E.C.2.

Ferrous and Non-Ferrous Metals in the Foundry.

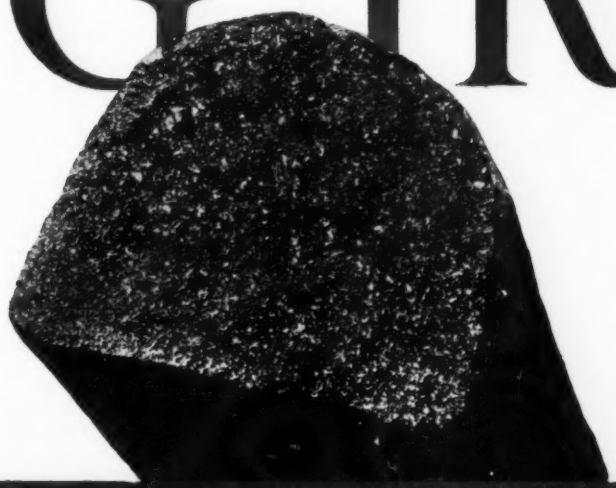
(*Concluded from page* 356.)

Conclusion.

In the somewhat general discussion on ferrous and non-ferrous metals in the foundry which has beea given above, I have made no attempt to go closely into detail since that would occupy a book rather than a Paper. I have endeavoured, however, somewhat sketchily to trace the points of difference and similarity between the two groups of metals with a view to stimulating interest in each branch of the industry in the work of the other, from which I am convinced that each has much to learn. But, above all, I have endeavoured to show that from the technical point of view the requirements of both branches of the industry are so closely allied that they should be pursued together. An immense amount of research work both in laboratories and in foundries is being carried on, while industrial trials of various kinds are innumerable. If one compares the published literature of the two branches one cannot but be struck by the fact that there is a great amount of duplication which could be saved if those interested in both branches could be induced to work closely together. In this country, although the Institute of British Foundrymen covers both branches of the industry, some of our other very important organisations do not. There is in the first place the separation between the Institute of Metals and the Iron and Steel Institute, and there is also the separate organisations of the Cast Iron Research Association and the Non-Ferrous Metals Research Association. I do not wish to suggest that these various organisations should be immediately amalgamated, but there is undoubtedly a large amount of common ground upon which duplication of effort could and should be avoided, and I hope that perhaps my brief review of this aspect of the subject may do something to help developments in that direction.

International Congress for Scientific Organisation of Labour.—The 5th International Congress for the Scientific Organisation of Labour is to be held in Amsterdam from July 18 to 23, 1932. The previous four Congresses were held respectively in Prague, Brussels, Rome and Paris. The General Secretary of the International Committee is Mr. Edmond Landauer, 33 Rue Ducale, Brussels.

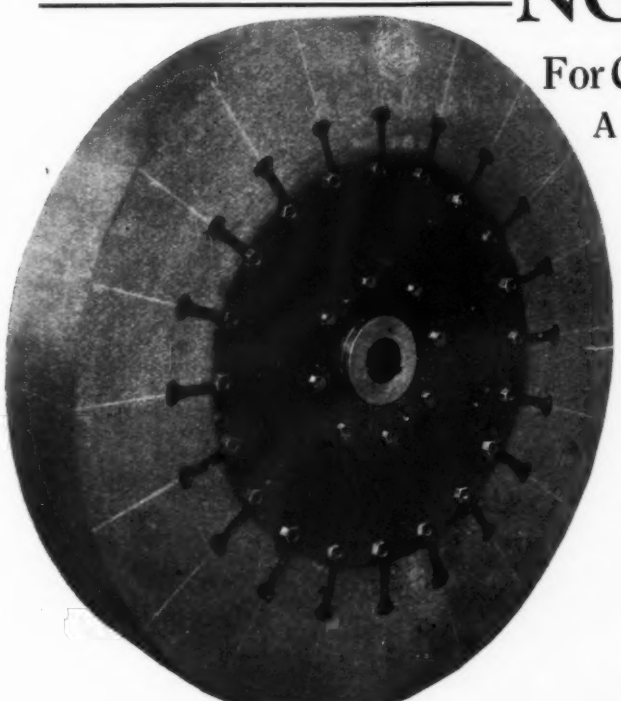
PIG IRON



Manufacturers of FOUNDRY, BASIC and HEMATITE qualities. Delivery from stock.
Booklet giving analyses, etc., will be sent on request.
DORMAN LONG & COMPANY LTD.,(Incorporating BOLCKOW VAUGHAN & Co., Ltd.,)MIDDLESBROUGH

DORMAN LONG

NORTON



For CUTLERY AND EDGE TOOL GRINDING

A new and improved large-diameter Segmental Wheel

THE Norton Segmental Wheel, introduced a few years ago, removed size limitations on manufactured wheels. Now they are regularly supplied up to 72 in. diameter and 14 in. thick. In the cutlery, textile and other industries where large-diameter quarried stones were in use the new wheels proved an immediate success, being more productive and more economical.

Now an improved wheel, known as the Type 6, is proving even more popular. Larger segments give more usable abrasive while a new design of mounting permits easy assembly at the consumer's plant. No longer is it necessary to return centres for mounting. Replacement segments are shipped as an assembled unit ready for mounting.

MADE IN ENGLAND BY
NORTON GRINDING WHEEL CO. LTD.
Factory at
WELWYN GARDEN CITY, HERTS.

SELLING REPRESENTATIVES
ALFRED HERBERT LTD. COVENTRY.
LONDON, GLASGOW, BIRMINGHAM, MANCHESTER, SHEFFIELD, BRISTOL, NEWCASTLE.

Raw Material Markets.

Trade remains poor in nearly all sections of the iron and steel markets, inactivity at the consuming works and the presence of large stocks of Continental material bought before the tariff being the chief reasons. Continental iron continues to come into Scotland and Wales, and Indian iron is also on offer. The finished-steel works find conditions very difficult, the few orders received being small and of miscellaneous character.

The appointment (by the Import Duties Advisory Committee) of a national committee to reorganise the iron and steel industry gives a more favourable aspect to the future. Although it will take some time for the committee to formulate its proposals, its mere appointment should act as a steadying influence on market quotations.

Pig-Iron.

MIDDLESBROUGH.—Exports of pig-iron during May were the lowest for some years, and the situation offers little encouragement. The local market remains depressed. Much of the output is, of course, absorbed in the Cleveland steelworks, but otherwise little merchant iron is being sold. Local prices are maintained, but there are reports of small concessions now being offered to consumers in various other districts, in addition to Scotland. The fixed local prices are:—No. 1 Cleveland foundry iron, 61s.; No. 3 Cleveland G.M.B., 58s. 6d.; No. 4 foundry, 57s. 6d.; No. 4 forge, 57s. per ton.

Prices of East Coast hematite are now being cut for future delivery, and even the prompt quotation has fallen 6d. to 62s. 6d. The fall is largely due to the announcement that a Middlesbrough firm is to resume hematite production in a short time. The consumption of West Coast hematite is very unsteady, the only steady call being from the Midlands. Bessemer mixed numbers remain at 66s per ton at works.

LANCASHIRE.—Business in pig-iron showed a slight increase last week, but there has been no improvement in the general situation at the consuming end. The foundries can find only irregular employment at the best, apart from one or two working on Russian orders. There has been no slackening of the offers of cast-iron scrap. For delivery to consumers in the Manchester price zone, Staffordshire, Derbyshire and North-East Coast makes of No. 3 are on offer at 67s. per ton, Northamptonshire iron at 65s. 6d., Derbyshire forge at 62s., Scottish foundry at from 86s. to 86s. 6d., and West Coast hematite at round 81s. Indian iron is quoted for delivery to users in the Manchester area at below 75s. per ton.

MIDLANDS.—The position of the pig-iron market is most discouraging. Contracts are running out and not being renewed, and little new business is being booked. Neither the light nor heavy foundries are in need of iron, owing to the slackness of trade. Quotations are 62s. 6d. for Northants No. 3 and 66s. for North Staffordshire, Derbyshire and Lincolnshire No. 3, including delivery to Birmingham and Black Country stations.

SCOTLAND.—Those founders still employed are buying only their day-to-day requirements, and business is almost at a standstill. No new contracts for Scottish iron are being made. The price of No. 3 foundry is on the official basis of 69s. 6d. per ton f.o.t. furnaces, with a minimum of 2s. 6d. per ton extra for No. 1. No. 3 Middlesbrough is 56s. 6d. per ton at Grangemouth, with Northamptonshire iron a shade cheaper.

Coke.

Conditions remain unchanged in the foundry-coke market, there being no improvement in the demand. Prices are unaltered, with best Durham grades at 37s. 6d. and upwards, and Welsh coke at from 30s. to 45s., according to tonnage and analysis, delivered Birmingham and district. Little or no forward buying has been observed.

Steel.

Little encouragement is to be gained from the situation in the semi-finished steel market. Orders are scarce, and a good proportion of the business is going to the Continental steelworks, which are quoting very low prices. In order to cope with this foreign competition, the home makers have revised their prices in one or two cases. Business in finished steel has fallen to a low level. Continental competition in small steel bars grows even keener, and very low prices are being quoted.

Scrap.

Little demand is being experienced in the Cleveland iron and steel scrap market, and prices are weak. A similar position rules in the Midlands, where heavy cast-iron machinery, broken into handy sizes, is offered at 47s. 6d. per ton delivered, good heavy pipe and plate at 42s 6d. per ton delivered, and clean light at 37s. 6d. per ton delivered. No improvement can be reported in the Scottish market, owing to the prevalent inactivity at many of the foundries. It is difficult to find buyers of first-class machinery, in pieces not exceeding 1 cwt., even at 45s. to 47s. 6d. per ton, and for ordinary cast to the same specification at 41s. 3d. to 42s. 6d. per ton. Light cast iron is still at 35s. to 36s. 6d. per ton, delivered f.o.t. consumers' works. Reports from South Wales indicate a similar lack of buying, heavy cast-iron scrap in large pieces and furnace sizes being at 44s. to 45s. and good cast-iron machinery scrap for foundry purposes at 45s. to 47s. 6d. per ton.

Metals.

Copper.—There has been a certain amount of hand-to-mouth buying by consumers in this country, but at very low prices. Copper Exporters maintain their official quotation of 6.25 cents c.i.f. Europe, but are offering Customs metal at 5.50 cents. There are reports, however, of outside sales being negotiated at as low as 5.25 cents. Little forward buying has been done, owing to the general uncertainty of the situation. French consumers have been buying wire bars for November shipment, but little other business has been done with the Continent.

Closing quotations :—

Cash.—Thursday, £26 to £26 2s. 6d.; Friday, £26 7s. 6d. to £26 10s.; Monday, £26 16s. 3d. to £26 18s. 9d.; Tuesday, £26 5s. to £26 7s. 6d.; Wednesday, £26 16s. 3d. to £26 17s. 6d.

Three Months.—Thursday, £26 to £26 2s. 6d.; Friday, £26 6s. 3d. to £26 8s. 9d.; Monday, £26 16s. 3d. to £26 18s. 9d.; Tuesday, £26 5s. to £26 7s. 6d.; Wednesday, £26 15s. to £26 17s. 6d.

Tin.—The failure of an important firm of metal brokers temporarily disorganised business on the London Metal Exchange, but its holdings of tin were taken over by a special pool and successfully disposed of. Dealings in tin were suspended on Monday, no quotations being issued.

Official closing prices :—

Cash.—Thursday, £119 5s. to £119 10s.; Friday, £119 15s. to £120; Monday, —; Tuesday, £115 5s. to £115 10s.; Wednesday, £115 15s. to £115 17s. 6d.

Three Months.—Thursday, £121 10s. to £121 15s.; Friday, £122 to £122 2s. 6d.; Monday, —; Tuesday, £117 15s. to £118; Wednesday, £118 to £118 2s. 6d.

Spelter.—Buying during the last two or three days has been mainly of a speculative character, although recently small purchases were made by the galvanising industry; the latter, however, is experiencing as poor conditions as ever. The next meeting of producers is to take place at Brussels on June 12, when the question of restriction of output will again come under review.

Daily fluctuations :—

Ordinary.—Thursday, £11 16s. 3d.; Friday, £11 16s. 3d.; Monday, £11 17s. 6d.; Tuesday, £11 17s. 6d.; Wednesday, £11 15s.

Lead.—There is a general lack of confidence in the future, and consumers are not buying until absolutely necessary. The continued fall in consumption throughout Europe is causing considerable anxiety to the producers. At a recent meeting, it is understood, they discussed a revival of the selling pool and further curtailment of production.

The week's prices have been :—

Soft Foreign (Prompt).—Thursday, £10 1s. 3d.; Friday, £10; Monday, £9 15s.; Tuesday, £9 16s. 3d.; Wednesday, £9 13s. 9d.

Students' Corner.

Q.—Can information be gained by reference to types of cupolas other than standard?

A.—Most experienced foundrymen have ideas of their own regarding the best type of cupola. The author has during his experience seen many weird arrangements in tuyeres and pipes which have reached from the bottom of the cupola to the top; these have had a season and passed away, and cropped up again, and owing to impracticability and misconceptions have often been failures. However, amongst special types of cupolas are the following, which chiefly differ regarding blast and blast inlet :—

(1) The centre-blast cupola tuyere.—The tuyere is placed in the centre of the cupola bottom, and comes into direct contact with the heated fuel and melted iron, hence it must be made of a special heat-resisting material, or protected by some such material. The tuyere is made of cast iron, and is provided with water space between the outside and the inside, through which a stream of water constantly flows when in operation.

(2) The Schurmann side-blast cupola with reversing regenerators.—It is claimed for this cupola that a saving in coke consumption is effected, due to the heated blast, and also increased temperature of the metal, low sulphur content, increased life of the lining, and a general improved quality of the metal.

(3) Oil-fired Wüst combination furnace and cupola in one unit for melting and refining cast iron.—This furnace is a combined reverberatory and cupola furnace fired with oil and built according to the Wüst principle and patents. It is claimed it can be worked continuously like a cupola furnace—that is, it possesses its advantages without its disadvantages.

(*To be continued.*)

Seeking a Line of Demarcation.

(*Concluded from page* 349.)

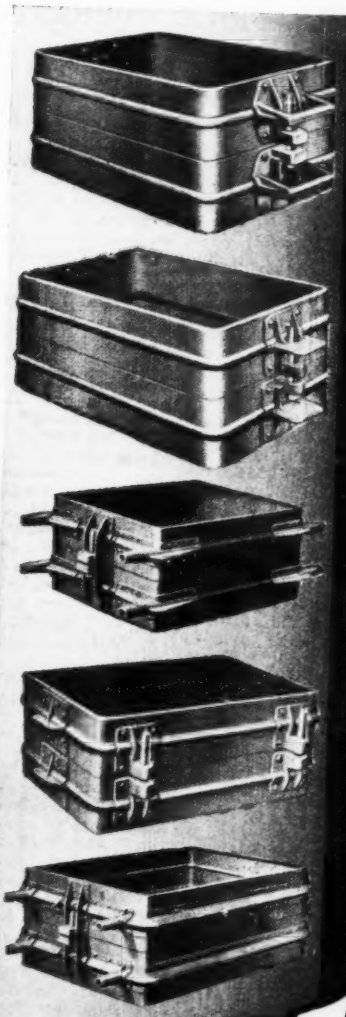
undoubtedly very largely an engineer's job of machines run by unskilled labour. He asked them to express their thanks to Mr. Gardner for coming and giving such an interesting Paper and a chance of discussing the ideas.

Mr. Gardner said that he appreciated the vote of thanks, he had enjoyed the discussion and had been interested in hearing the various reasons for the use of green-sand or dry-sand moulding, but he had not yet discovered the exact reasons for deciding the method to be used in a particular case or the limits to green sand. He had been able to show them photographs of some of the plant at Messrs. Glenfield & Kennedy's works, but possibly an inspection of the actual plant would be of interest to them. He had, therefore, much pleasure in extending an invitation to the members of the Branch to visit the works during the summer.

Mr. N. McManus said that on behalf of the Scottish Branch he was gratified at the large attendance and the enthusiasm shown by East of Scotland foundrymen. He also wished to thank Mr. Wallace for coming along and presiding at the meeting. During the next session it was intended to hold at least four meetings in Edinburgh, and the Council would be very glad to have an indication of the type of Papers which the members would prefer to have read, and they would do their best to provide them.

Mr. Wallace said he was obliged for the vote of thanks and would like to say how much they appreciated the Glasgow peoples' presence to encourage them.

XUM



STERLING FOUNDRY SPECIALTIES LTD. BEDFORD.

LONDON OFFICE —
13, VICTORIA STREET, S.W.1.

TELEPHONE :—
3345 BEDFORD.

TELEGRAMS :—
"STERFLASK, BEDFORD."

.....they play an important part in modern foundry production —— save unnecessary labour, produce accurate castings & reduce your Box Maintenance costs —

Sterling

SOLID RIBBED ROLLED STEEL

FOUNDRY MOULDING BOXES

WEEKLY PRICE CURRENT.

COPPER.

	£ s. d.
Standard cash	26 16 3
Three months	26 15 0
Electrolytic	30 10 0
Tough	28 15 0
Best selected	29 5 0
Sheets	59 0 0
India	40 0 0
Wire bars	33 7 6
Do., July	32 10 0
Do., Aug.	31 10 0
Ingot bars	33 7 6
H.C. wire rods	35 0 0
Off. av. cash, May	28 11 11½
Do., 3 mths., May	28 12 7½
Do., Sttlmnt., May	28 11 9½
Do., Electro, May	33 6 8
Do., B.S., May	31 16 4½
Do., wire bars, May	33 16 8
Solid drawn tubes	9½d.
Brazed tubes	9½d.
Wire	6½d.

BRASS.

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	7½d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7½d.
Wire	7½d.
Rolled metal	6¾d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5½d.
Do. 4 × 3 Sheets	5¾d.

TIN.

	£ s. d.
Standard cash	115 15 0
Three months	118 0 0
English	117 5 0
Bars	118 15 0
Straits	119 10 0
Australian	117 5 0
Eastern	—
Banca (nom.)	123 5 0
Off. av. cash, May	122 7 6
Do., 3 mths., May	124 10 1½
Do., Sttlmt., May	122 8 1½

SPELTER.

	£ s. d.
Ordinary	11 15 0
Remelted	11 0 0
Hard	9 10 0
Electro 99.9	14 10 0
English	12 17 6
India	11 10 0
Zinc dust	21 0 0
Zinc ashes	1 15 0
Off. aver., May	12 11 1½
Aver. spot, May	12 8 7½

LEAD.

	£ s. d.
Soft foreign ppt.	9 13 9
Empire	10 10 0
English	11 15 0
Off. average, May	10 17 1
Average spot, May	10 13 5½

ZINC SHEETS, &c.

	£ s. d.
Zinc sheets, English	23 0 0
Do., V.M. ex-whf.	20 0 0
Rods	27 0 0
Boiler plates	—
Battery plates	—

ANTIMONY.

	£ s. d. to £ s. d.
English	35 0 0 to 42 10 0
Chinese	24 0 0
Crude	16 0 0

QUICKSILVER.

	£ s. d.
Quicksilver	13 0 0

FERRO-ALLOYS AND STEEL-MAKING METALS.

Ferro-silicon—	
25%	8 5 0
45/50%	13 12 6
75%	18 17 6
Ferro-vanadium—	
35/50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% c. free, of Mo.	6/3 per lb.
Ferro-titanium—	
23/25% carbon-free	11d. lb.
Ferro-phosphorus, 20/25%	£21 0 0
Ferro-tungsten—	
80/85%	2/- lb.
Tungsten metal powder—	
98/99%	2/3½ lb.
Ferro-chrome—	
2/4% car.	£27 15 0
4/6% car.	£25 2 6
6/8% car.	£24 10 0
8/10% car.	£23 17 6
Ferro-chrome—	
Max. 2% car.	£37 10 0
Max. 1% car.	£47 2 6
Max. 0.70% car.	£49 12 6
70% carbon-free	1/1½ lb.
Nickel—80/99.5%	£225 to £230
"F" nickel shot	£207 0 0
Ferro-cobalt	9/3 lb.
Aluminium 98/99%	£95 0 0
Metallic chromium—	
96/98%	2/9 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 0 0
Metallic manganese—	
94/96% carbon-free	1/5 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL.

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—

Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to $\frac{3}{16}$ in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ½ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP.

	£ s. d.	£ s. d.
South Wales—		
Heavy steel	1 19 0	to 2 1 0
Bundled steel and shrngs.	1 16 0	to 1 18 6
Mixed iron and steel	1 16 0	to 1 18 0
Heavy cast iron	2 4 0	to 2 5 0
Good machinery for foundries	2 5 0	to 2 7 6
Cleveland—		
Heavy steel	1 15 0	
Steel turnings	1 12 6	
Cast-iron borings	1 6 0	
Heavy forge	2 12 6	
W.I. piling scrap	2 5 0	
Cast-iron scrap	1 17 6	
Midlands—		
Light cast-iron scrap	1 17 6	
Heavy wrought iron	2 10 0	
Steel turnings, f.o.r.	0 19 0	
Scotland—		
Heavy steel	1 17 6	
Ordinary cast iron	2 2 0	
Engineers' turnings	1 8 6	
Cast-iron borings	1 10 0	
Wrought-iron piling	2 2 6	
Heavy machinery	2 5 0	

London—Merchants' buying prices delivered yard.

Copper (clean)	24 0 0
Brass	16 0 0
Lead (less usual draft)	8 0 0
Tea lead	6 0 0
Zinc	6 10 0
New aluminium cuttings	72 0 0
Brasiery copper	21 0 0
Gunmetal	21 0 0
Hollow pewter	70 0 0
Shaped black pewter	50 0 0

PIG-IRON.

(f.o.t. unless otherwise stated.)

N.E. Coast—	
Foundry No. 1	61/-
Foundry No. 3	58/6
Foundry No. 4	57/6
Forge No. 4	57/-
Hematite No. 1	63/-
Hematite M/Nos.	62/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/-
d/d Birm.	84/6
Malleable iron d/d Birm.	117/6
Midlands—	
Staffs common*	—
No. 4 forge*	61/-
No. 3 fdry.*	66/-
Shrops basic	—
Cold blast, ord.	—
roll iron	—
Northants forge*	57/6
fdry. No. 3*	62/6
fdry. No. 1*	65/6
Derbyshire forge*	61/-
fdry. No. 3*	66/-
fdry. No. 1*	69/-
basic*	—

*d/d Black Country dist.

Scotland—	
Foundry No. 1	72/-
No. 3	69/6
Hem. M/Nos. d/d	68/6
Sheffield (d/d district)—	
Derby forge	58/6
fdry. No. 3	63/6
Lincs forge	—
fdry. No. 3	63/6
E.C. hematite	75/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby forge	62/-
fdry. No. 3	67/-
Staffs fdry. No. 3	67/-
Northants fdry. No. 3	65/6
Cleveland fdry. No. 3	67/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	86/- to 86/6
Clyde, No. 3	86/- to 86/6
Monkland, No. 3	86/- to 86/6
Summerlee, No. 3	86/- to 86/6
Eglinton, No. 3	86/- to 86/6
Gartsherrie, No. 3	86/- to 86/6
Shotts, No. 3	86/- to 86/6

FINISHED IRON AND STEEL.

Usual District deliveries for iron; delivered consumers' station for steel.

	£ s. d.	£ s. d.
Iron—		
Bars (cr.)	9 7 6	to 9 15 0
Nut and bolt iron	7 15 0	to 8 10 0
Hoops	10 10 0	to 12 0 0
Marked bars (Staffs) f.o.t.	12 0 0	
Gas strip	10 10 0	to 12 0 0
Bolts and nuts, ¾ in. × 4 in.	12 0 0	
Steel—		
Plates, ship, etc.	8 15 0	to 8 17 6
Boiler plts.	8 7 6	to 9 5 0
Chequer plts.	10 7 6	
Angles	8 7 6	
Tees	9 7 6	
Joists	8 15 0	
Rounds and squares, 3 in. to 5½ in.	9 7 6	
Rounds under 3 in. to ⅜ in. (Untested)	6 12 6	& up.
Flats—8 in. wide and over	8 12 6	
„ under 8 in. and over 5 in.	8 17 6	
Rails, heavy	8 5 0	to 8 10 0
Fishplates	12 0 0	
Hoops (Staffs)	9 10 0	
Black sheets, 24g.	8 0 0	to 8 10 0
Galv. cor. shts.	9 5 0	to 10 0 0
Galv. flat shts.	9 15 0	to 11 0 0
Galv. fencing wire, 8g. plain	12 7 6	
Billets, soft	4 17 6	to 5 7 6
Billets, hard	6 12 6	
Sheet bars	4 15 0	to 5 7 6
Tin bars	4 15 0	

PHOSPHOR BRONZE.

	Per lb. basis.
Strip	10½d.
Sheet to 10 w.g.	11½d.
Wire	11½d.
Rods	10½d.
Tubes	16d.
Castings	12d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL.

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	14.84
No. 2 foundry, Valley	14.50
No. 2 foundry, Birm.	11.00
Basic	15.89
Bessemer	16.89
Malleable	16.89
Grey forge	16.39
Ferro-mang. 80%, seaboard	75.00
O.-h. rails, h'y, at mill	43.00
Billets	27.00
Sheet bars	26.00
Wire rods	37.00
	Cents.
Iron bars, Phila.	2.11
Steel bars	1.60
Tank plates	1.60
Beams, etc.	1.60
Skelp, grooved steel	1.60
Skelp, sheared steel	1.60
Steel hoops	1.65
Sheets, black, No. 24	2.20
Sheets, galv., No. 24	2.85
Wire nails	1.95
Plain wire	2.20
Barbed wire, galv.	2.60
Tinplates, 100-lb. box	$4.75

COKE (at ovens).

Welsh foundry	22/6 to 25/-
„ furnace	17/- to 18/-
Durham and Northumberland—	
„ foundry	21/- to 25/-
„ furnace	13/- to 13/6
Midlands, foundry	—
„ furnace	—

TINPLATES.

f.o.b. Bristol Channel ports.

I.C. cokes 20×14 per box	14/6 to 15/-
„ 28×20 „	29/- to 30/-
„ 20×10 „	—
„ 18¾×14 „	—
C.W. 20×14 „	—
„ 28×20 „	—
„ 20×10 „	—
„ 18¾×14 „	—

SWEDISH CHARCOAL IRON & STEEL.

Pig-iron	£6 0 0 to £7 0 0
Bars, hammered, basis	£16 10 0 to £17 0 0
Bars and nail-rods, rolled, basis	£15 17 6 to £16 5 0
Blooms	£10 0 0 to £12 0 0
Keg steel	£32 0 0 to £33 0 0
Faggot steel	£18 0 0 to £23 0 0
Bars and rods dead soft, st'l	£10 0 0 to £12 0 0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS.

Standard Copper (cash).

		£	s.	d.		
June	2 ..	26	0	0	dec.	15/-
,,	3 ..	26	7	6	inc.	7/6
,,	6 ..	26	16	3	,,	8 9
,,	7 ..	26	5	0	dec.	11/3
,,	8 ..	26	16	3	inc.	11/3

Electrolytic Copper.

		£	s.	d.		
June	2 ..	30	10	0	dec.	20/-
,,	3 ..	30	10	0	No	change
,,	6 ..	30	10	0	,,	,,
,,	7 ..	30	10	0	,,	,,
,,	8 ..	30	10	0	,,	,,

Standard Tin (cash).

		£	s.	d.		
June	2 ..	119	5	0	dec.	57/6
,,	3 ..	119	15	0	inc.	10/-
,,	6 ..	—		—		
,,	7 ..	115	5	0	dec.	90/-
,,	8 ..	115	15	0	inc.	10/-

Tin (English ingots).

		£	s.	d.		
June	2 ..	120	15	0	dec.	40/-
,,	3 ..	121	10	0	inc.	15/-
,,	6 ..	—		—		
,,	7 ..	116	15	0	dec.	95/-
,,	8 ..	117	5	0	inc.	10/-

Spelter (ordinary).

		£	s.	d.		
June	2 ..	11	16	3	dec.	5/-
,,	3 ..	11	16	3	No	change
,,	6 ..	11	17	6	inc.	1/3
,,	7 ..	11	17	6	No	change
,,	8 ..	11	15	0	dec.	2/6

Spelter (Electro, 99.9 per cent.).

		£	s.	d.		
June	2 ..	14	5	0	dec.	7/6
,,	3 ..	14	5	0	No	change
,,	6 ..	14	5	0	,,	,,
,,	7 ..	14	10	0	inc.	5/-
,,	8 ..	14	10	0	No	change

Zinc Sheets (English).

		£	s.	d.		
June	2 ..	23	0	0	No	change
,,	3 ..	23	0	0	,,	,,
,,	6 ..	23	0	0	,,	,,
,,	7 ..	23	0	0	,,	,,
,,	8 ..	23	0	0	,,	,,

Lead (English).

		£	s.	d.		
June	2 ..	12	0	0	dec.	5/-
,,	3 ..	12	0	0	No	change
,,	6 ..	11	15	0	dec.	5/-
,,	7 ..	11	15	0	No	change
,,	8 ..	11	15	0	,,	,,

AVERAGE MONTHLY PRICES OF MARKED BARS (SOUTH STAFFS).

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1898	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	8 0 0	8 0 0	7 11 8
1899	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 10 0	9 0 0	9 0 0	9 10 0	10 0 0	10 0 0	10 0 0	8 3 4
1900	11 0 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 10 0	11 5 10
1901	9 10 0	9 10 0	9 10 0	9 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 16 8
1902	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 5 0	8 7 6
1903	8 5 0	8 5 0	8 5 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 8 9
1904	8 10 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 10
1905	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 10 0	8 10 0	8 1 8
1906	8 10 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	8 10 0	8 10 0	8 10 0	8 10 0	9 0 0	8 15 10
1907	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0
1908	9 0 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 5 10
1909	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1910	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1911	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0	8 0 0
1912	8 10 0	8 10 0	8 10 0	8 15 0	9 0 0	9 0 0	9 0 0	9 8 0	9 10 0	9 10 0	9 10 0	9 15 0	9 1 6
1913	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	10 0 0	9 10 0	9 10 0	9 4 0	9 0 0	9 0 0	9 13 8
1914	8 12 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	8 10 0	9 0 0	9 0 0	9 0 0	9 0 0	9 0 0	8 14 4
1915	9 0 0	9 0 0	9 3 0	10 2 0	10 15 0	11 10 0	12 0 0	12 0 0	12 0 0	12 7 6	12 10 0	13 10 0	11 5 0
1916	13 10 0	13 10 0	14 13 0	15 0 0	15 0 0	15 0 0	15 0 0	15 10 0	15 10 0	15 0 0	15 10 0	15 0 0	14 18 7
1917	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0	15 10 0
1918	15 12 6	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	16 0 0	17 0 0	17 0 0	17 0 0	16 6 3
1919	18 0 0	18 10 0	20 0 0	20 0 0	23 0 0	23 0 0	23 0 0	24 12 0	25 0 0	25 0 0	25 0 0	25 5 0	22 10 7
1920	26 17 6	27 0 0	28 0 0	30 5 0	30 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	33 10 0	31 10 2
1921	31 10 0	30 3 4	27 10 0	27 10 0	27 10 0	24 15 0	21 0 0	20 0 0	20 0 0	17 10 0	17 0 0	16 0 0	23 7 4
1922	16 0 0	14 17 6	14 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 18 1½
1923	13 10 0	13 10 0	13 16 0	14 7 6	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 5 3½
1924	14 10 0	14 10 0	14 10 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 17 6	14 17 3½
1925	15 0 0	15 0 0	15 0 0	15 0 0	15 0 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	14 0 0	14 13 4
1926	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	14 0 0	*	14 10 0	14 0 10
1927	14 10 0	14 10 0	14 10 0	14 10 0	14 10 0	13 10 0	13 10 0	13 10 0	13 10 0	13 0 0	13 0 0	12 18 0	13 15 8
1928	12 10 0	12 10 0	12 10 0	12 2 6	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 2 8½
1929	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 7 6	12 10 0	12 10 0	12 2 3½
1930	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0	12 10 0
1931	12 10 0	12 10 0	12 10 0	12 8 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	12 3 2
1932	12 0 0	12 0 0	12 0 0	12 0 0	12 0 0	—	—	—	—	—	—	—	—

* No quotation available.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK LUMPS

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

CENTRAL CHAMBERS, 93, HOPE ST., GLASGOW, C.2.

ZETLAND ROAD, MIDDLESBROUGH.

SMALL ADVERTISEMENTS.

Notice.

Small Advertisements in this section of the Journal are accepted at the prepaid rate of 6d. per line, first line in capitals counting two, average 6 words per line. Minimum charge for one insertion 3/-

(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED.

FOUNDRY Works Manager desires position; practical and technical training all branches iron and non-ferrous, thorough knowledge of stainless steel, expert on cupola, experienced engineering and patternshop; good organiser.—Box 166, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

METALLURGICAL and Analytical Chemist desires post in foundry or works laboratory; age 30 years; 12 years' practical and technical experience and general management with marine engineering firm manufacturing cast-iron and semi-steel castings, etc.; highest references.—Box 202, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED, Foreman for Motor-cylinder Foundry in Midlands. Must have sound knowledge of all branches. Able to fix own piecework prices. Only men capable of producing high-class castings at competitive prices need apply. Good salary for right man.—Age, experience, etc., to Box 198, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOREMAN MOULDER seeks position; 10 years in charge of plate and machine foundry of large engineering firm. Excellent references. Age 48. (177)

EXPERIENCED Foundry Foreman requires position. Experience on machine moulding, pipe founding, and general engineering castings. Technical training. (178)

FOUNDRY and General Works Foreman disengaged; 30 years' experience in production of intricate light castings, for music, engineering and electrical trades, also in the assembling, enamelling and stoving. (179)

EXPERIENCED Foundry Manager, 15 years in charge of well-known foundries doing highest-class iron and non-ferrous castings, requires position. Latest position complete control, works and commercial. Exceptional experience special irons, including Perlit." (180)

FOUNDRY Foreman, age 39, requires position; 16 years' experience in charge of foundries. Cast-iron, semi-steel, aluminium and all non-ferrous alloys, also repetition work and light castings. (181)

AGENCY.

AGENTS wanted on Commission Basis in London area to represent foundry doing iron and non-ferrous castings.—Write, giving full particulars, to Box 200, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATENTS AND TRADE MARKS.

PROTECT YOUR IDEAS.—Free, "Advice Handbook" on patenting inventions and registering trade marks by Registered Agent with 45 years' experience.—KINGS PATENT AGENCY, LIMITED, 146A, Queen Victoria Street, E.C.4.

THE Proprietor of the Patent No. 285814 for "Process for the Manufacture of Steel" is desirous of entering into arrangements by way of licence and otherwise on reasonable terms for the purpose of exploiting the same and ensuring its full development and practical working in this country.—All communications should be addressed in the first instance to Haseltine, Lake & Company, 28, Southampton Buildings, Chancery Lane, London, W.C.2.

THE Proprietor of British Patent No. 308517, dated May 30, 1928, relating to "Improvement in a Hot Top for Ingot Moulds," is desirous of entering into arrangements by way of a licence or otherwise on reasonable terms for the purpose of exploiting the above patent and ensuring its practical working in Great Britain.—Inquiries to B. Singer, Steger Building, Chicago, Illinois.

PUBLICATION.

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1932 edition. Now ready. Price 42s., bound in cloth.—INDUSTRIAL NEWSPAPERS, LTD., 49, Wellington Street, Strand, London, W.C.2.

PROPERTY.

MAGNIFICENT

11 ACRES WORKS SITE.

SHEFFIELD.

145,000 Sq. Ft. of Shops.

SIDING CONNECTIONS

with L.M. & S. and L. & N.E. Rlys.

WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—

THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD.

FOR Sale, London district, Iron Foundry; capacity 20 tons per week; ample scope for development; machine shops available; modern equipment; long lease, low ground-rent and low rates.—Box 192, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

MACHINERY.

FOR Sale, Denison Foundry Testing Machine for tensile and transverse tests. In perfect condition, £38. Also Brinell Machine, £25.—T. C. HOWDEN & COMPANY, 7, Fleet Street, Birmingham.

FOR Sale.—One No. 6 Thwaites Type BLOWER, complete with Bedplate and Pulleys for belt drive. In good condition.—Further particulars on application to Box 196, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

THOS. W. WARD, LTD.

3 BABCOCK W.T. BOILERS, 160 lbs. press.
6-ton Clayton Tipping STEAM WAGON, 200 lbs. press.
STEEL BUILDING, 37' long x 19' x 19' 6" high.
25/30 tons GALVSD. CORRUGATED SHEETS, 7/8 ft. long.
500 PUMPS IN STOCK—ALL TYPES. Capacities from 300 to 300,000 galls. per hr.

ALBION WORKS, SHEFFIELD.

'Grams: Forward, Sheffield. 'Phone, 23001.
"Albion" Catalogue on application.

MACHINERY—*Continued.*

FOR Sale.—Two CUPOLAS, 45 in. inside linings, Whiting type, complete with spark arresters, ash chutes, fans and motors. Drop bottom doors, double row tuyeres.—Apply, SIR W. G. ARMSTRONG-WHITWORTH & COMPANY (IRONFOUNDERS), LIMITED, Gateshead-on-Tyne.

MISCELLANEOUS.

STRAW ROPES.—For honest and reliable service always come to WILLIAM OLSEN, LIMITED, Cogan Street, Hull.

'Phone: 287 SLOUGH

LADLES—GEARED

12-Ton "Stevenson"	... ...	£48
9-Ton "MacNeil"	... ...	£42
4-Ton "Evans"	... ...	£28
3-Ton "Evans"	... ...	£24
2-Ton "Evans"	... ...	£19

PNEUMATIC MACHINES

14"×16" Mumford split pattern	2 @ £35
No. 2 Britannia Jolters	... 2 @ £36
No. 0 Britannia Jolters	... 4 @ £20
Core Jolters, 3" Cylinder new, unused	... £4 each

ABOVE ARE AS NEW.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

To Engineers, Founders, Manufacturers. Fine site of nearly 3 acres on Arterial Road with Foundry and Workshops and own Rail Sidings into premises. Modern Offices, Warehouse and Workrooms. Central Heating.

CHARLES A. TRICKS & SON,
Auctioneers,
ST. NICHOLAS STREET, BRISTOL.

Bradley's

REFINED
ALLOY IRONS

A new range of compositions containing varying proportions of Nickel, Chromium, Vanadium, Titanium, etc., suitable for wear and corrosion resistance, castings required to withstand high temperature, acid resistance and for high strength, toughness and resilience qualities. The use of Alloy Pig Irons ensures homogeneous castings, avoids segregation and ladle losses and gives 100% benefit from alloy additions.

BRADLEY & FOSTER LIMITED
DARLASTON BLAST FURNACES,
DARLASTON, STAFFS

Telephone: Darlaston 16 (P.B. Ex.)
Telegrams: "Bradley's, Darlaston."

XUM